The Bay Area – A Knowledge Economy Needs Power

A Report on California's Energy Crisis and its Impact on the Bay Area Economy

Bay Area Economic Forum
A partnership of the Bay Area Council and the Association of Bay Area Governments

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BAY AREA COUNCIL

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Contributors from McKinsey & Company included Jim Robb, Principal in McKinsey's San Francisco office, who also directed the project, Olga Perkovic, Tony Sugalski, Paul Lee, and Brent Neiman. This group drew substantively upon the efforts of a number of other McKinsey colleagues including Tim Bleakley, Adrian Reed, and their team, as well as a host of others.

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THE BAY AREA – A KNOWLEDGE ECONOMY NEEDS POWER

The Bay Area's rapid growth is threatened by several major infrastructure weaknesses, the most urgent being the California power shortage. Basic understanding of the underlying microeconomic causes and the potential economic impact of the energy crisis has been woefully inadequate so far. PG&E's recent bankruptcy filing signals that progress in crafting solutions is not being made as quickly as is necessary for the state's economic well-being. This report contains a comprehensive analysis of the energy situation. It is intended to catalyze discussion and propose potential solutions to keep the Bay Area economy, and indeed all of California, from running out of fuel.

The root cause of this crisis is clear; the California economy, and energy consumption, have grown steadily while no new capacity has come on-line. The supply-demand imbalance became acute in 2000. Consumers did not initially notice the imbalance because their retail prices have been fixed, while the utilities, forced to pay skyrocketing wholesale electricity prices, have been driven to extreme measures, including bankruptcy. Normally, prices act as a mechanism to bring supply and demand into balance. However, when neither supply nor demand adjust, as in California today, the only method of rationing power is a blackout, at huge cost to businesses and residents.

As much as one-third to one-half of the increase in wholesale power prices last year was due to the higher cost of producing electricity and, with demand sufficiently large, dependence on the least efficient and highest-cost power generators that consume increasingly costly natural gas as a fuel. The need to bring supply and demand into balance, and the market structure flaws that made this difficult, are likely responsible for the reminder of the increase in wholesale prices.

In launching this report, the Bay Area Economic Forum was concerned that the Bay Area economy would be particularly exposed to this crisis. High technology businesses, which have led the region's growth, require exceptionally high power reliability. Without it, they risk becoming uncompetitive and may move elsewhere. In the course of conducting this research, it also became clear that more than just high technology businesses are at risk. A lack of reliable power presents a clear threat to the broader economy, far overshadowing the impact of any price increases.

This report explains the microeconomic forces that caused the current crisis, details the potential impact on the economy, and recommends solutions to bring about a properly functioning market and long-term benefits to all Californians. In the short-term, demand must be curbed. In the longer term, California must strengthen its energy infrastructure (gas and electricity). Moreover, political expediency in resolving the crisis today should not come at the expense of the long-term competitiveness of the economy and the prosperity of California residents. The inclination to re-regulate is not a good one. A functioning, competitive wholesale and retail power market is the best way to bring the most power at the lowest prices to the state.

WHAT IS BEHIND THE CALIFORNIA ENERGY CRISIS

While electricity supply crises are familiar in the Third World, they long ago ceased to be a concern in the U.S. Today, however, they are a fact of life in California, and similar factors are behind them. The current energy situation was driven by an imbalance between supply and demand in both gas and electricity and a lack of new investment in generating and transmission capacity. This imbalance has been aggravated by flawed electric market structures, which did not adequately attract new capacity or permit demand to respond to elevated prices. In addition, California's peculiar market structures may put too much power in the hands of producers, particularly when supplies are tight.

When California pursued power market deregulation in the mid-1990s, the state's electric rates were among the highest in the country. This was due to a high-cost mix of supply sources, including nuclear power and renewable energy, and low per capita usage levels because of California's energy efficiency priorities and mild climate. Advances in generation technology and low natural gas prices across the country led large energy consumer advocates to seek direct access to lower-cost power than was provided by the state's utilities. Indeed, deregulation was intended to force the state's utilities to buy power at more competitive rates and thereby lower the cost of electricity in the state. Since there was significant overcapacity in the Western U.S., introducing competition in the electric generation market should have been easy.

Deregulation proceeded in a series of steps.[1] The wholesale market (where generators and marketers sell power and utilities buy it) started to deregulate in the 1970s when non-utility generators first appeared. These new entrants demanded the right to sell power to consumers who were connected to power lines by the state's utilities. To spur even more competition amongst power providers, the California Legislature passed a bill in 1996 requiring the utilities to divest large portions of their fossil fuel generating stations. Simultaneously, the Power Exchange and Independent System Operator (ISO) were launched to connect power suppliers, both in and out of California, with the state's utilities and their customers.

Retail markets were also technically deregulated in 1998;[2] however, prices for most business and residential power consumers were to remain fixed through the end of 2002, and regulated by the California Public Utility Commission (CPUC). This was designed to allow the utilities to recover a large portion of their "stranded costs," the costs incurred when they built most of the state's power facilities. In order to increase the number of participants and liquidity in the wholesale markets – which was limited previously since the utilities primarily "bought" power from their own generators – the state confined utility purchases to three spot markets: the day ahead, day of, and the real-time market. These markets were run by the public Power Exchange and the ISO.

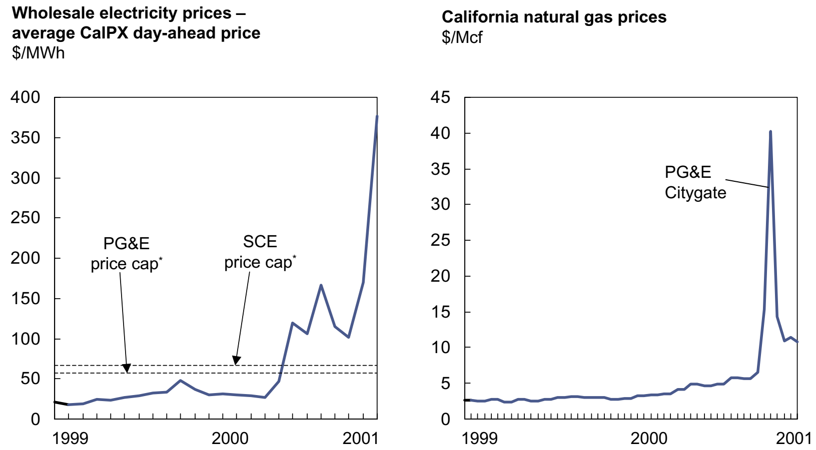
1 The key piece of legislation that put the deregulation process in motion was AB 1890. It was passed in 1996 and took effect in 1998.

2 Customers were given the option of "Direct Access" to power suppliers other than their host utility (although the utilities continued to distribute power across their wires infrastructure). This too was a result of AB 1890.

For the first two years of "deregulation," the market worked as intended. Wholesale prices dropped to about 50% of the pre-deregulation utility power cost,[3] from an average of $60-65 per megawatt hour (excluding transmission and distribution cost) to $32 / MWh in 1999. Utilities were capturing the spread and making solid progress toward paying off their billions in stranded costs. However, in 2000, average wholesale power prices almost quadrupled to levels well above what utilities were allowed to charge. Supply became unreliable and the number of Stage 2 and Stage 3 emergency warnings[4] from the ISO increased dramatically. At the same time, the cost of natural gas had risen dramatically over the previous year, straining California consumers' energy bills since, unlike electricity, gas rates were already deregulated (Exhibit 1).[5]

EXHIBIT 1

CALIFORNIA WHOLESALE ELECTRICITY AND GAS PRICES



* Estimated by utilities by applying the true price cap to total bundled rates

Source: Energy Information Administration; Natural Gas Monthly; Brent Friedenberg & Associates; Wholesale Electricity Price Review; CEC; Economy.com; Western Gas Review; Energy ERA; RDI Gas Data

3 This is the blended average cost of producing power from the collection of assets owned by the utility, including nuclear, hydro, and fossil fuel plants, as well as some renewable energy sources.

4 Warnings issued by CaISO when operating margins fall below specified levels, indicating that the risk of blackouts is especially high.

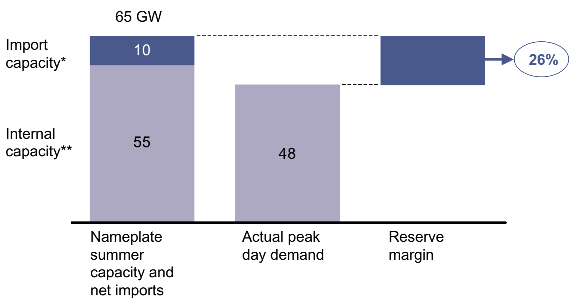
5 Natural gas is subject to regulation by the federal government, not the state. It has been fully deregulated for a number of years.

WHAT HAS CHANGED SINCE DEREGULATION BEGAN

When deregulation began in 1994, total available supply[6] exceeded demand by a comfortable 26% (Exhibit 2), leading observers to conclude that wholesale prices would remain well below fixed retail prices since there were so many competitors trying to sell their energy. Since electricity cannot be stored, a cushion of additional generating capacity is necessary to keep prices competitive, meet peak demand, and cover for times when precipitation is low and hydroelectric levels are down or plants are off-line for maintenance. Normally, a 15% cushion is considered adequate for the Western U.S. In the last 6 years, a slight reduction in internal California capacity combined with steadily increasing demand (Exhibit 3) reduced this margin, such that in 1999, the reserve margin forecast for 2000 was only 12%. However, as 2000 unfolded, a number of unanticipated factors, including outages, reduced imports, and unusually high demand,[7] dramatically reduced the reserve margin to only 3.5% in the summer of 2000 and 6.8% in the winter (Exhibit 4). Effectively, every generator could sell every kilowatt at any price since there were no alternatives.

When demand exceeds supply in an open market, price is the mechanism that brings these forces into balance. But a number of factors precluded producers from rushing to market with increased supply. In fact, available supply in 2000 was actually reduced as wholesale price caps in California drove energy producers to sell their power elsewhere where they could get higher prices. Further, the capacity additions forecasted for California over the past decade were shelved because the regulations kept changing, creating uncertainty, and because of an arduous permitting process. Moreover, since there was no market to buy energy in the future, a so-called forward market, there were inadequate price signals to potential investors to stimulate building more power stations and insufficient opportunities to hedge price risks (Exhibit 5).

EXHIBIT 2
CALIFORNIA ELECTRICITY RESERVE MARGIN 1994 ESTIMATES

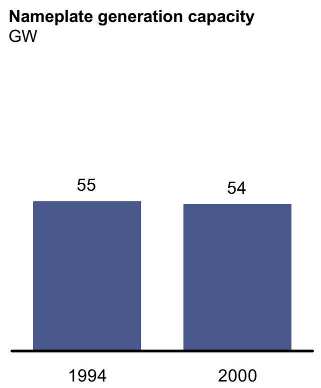


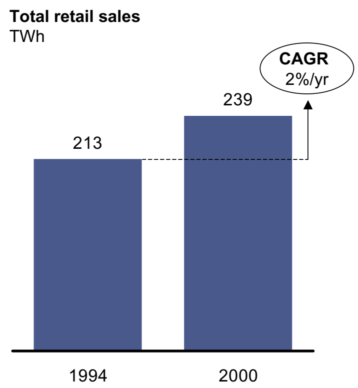
* Firm transmission capacity contracted (net of export), forecast in 1993 for 1994
** Actual summer peak capacity for CANV subregion (Nevada has no generation capacity within the CANV subregion)
Source: FERC; NERC ES&D database; CalSO; project team analysis

6 Total available supply is the most appropriate measure given the extensive resource sharing throughout the Western States Coordinating Council (WSCC). Seasonal power flows are critical to all western states. In the winter, power flows into the Northwest, whereas in the summer, power (mostly from hydro sources) flows south to cover increased air conditioning load.

7 Statewide, total electric consumption had been increasing by about 2% per year. In 2000, the rate of increase exceeded 4%. This is double historical rates; in the context of already strained infrastructure and tight supply conditions, it is quite significant. In addition, peak load increased by more than 8% on average during the months of May to September (as compared to the same months in 1999), driven by exceedingly large increases in May and June.

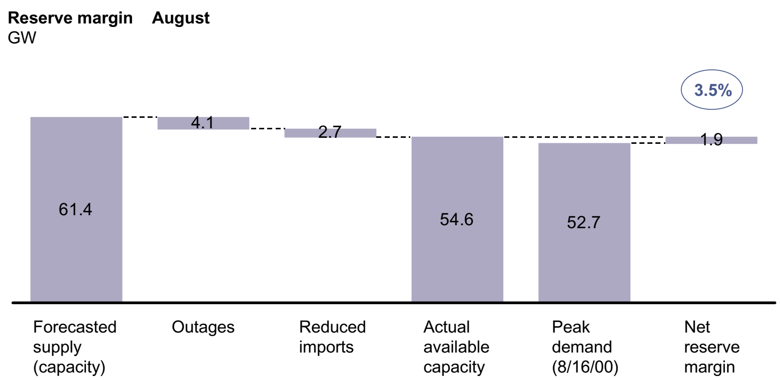
EXHIBIT 3
CALIFORNIA SUPPLY AND DEMAND 1994-2000





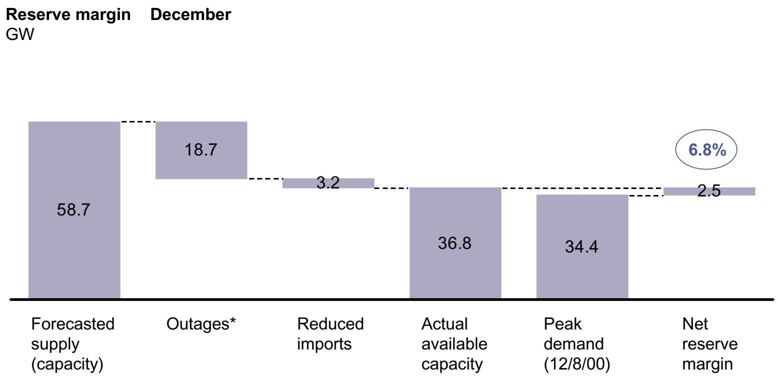
Source: RDI PowerDat; CalSO; project team analysis

EXHIBIT 4A
CALIFORNIA RESERVE MARGIN AUGUST 2000 ESTIMATES



Source: Press releases; CalSO; WSCC; NERC; FERC; RDI PowerDat; project team analysis

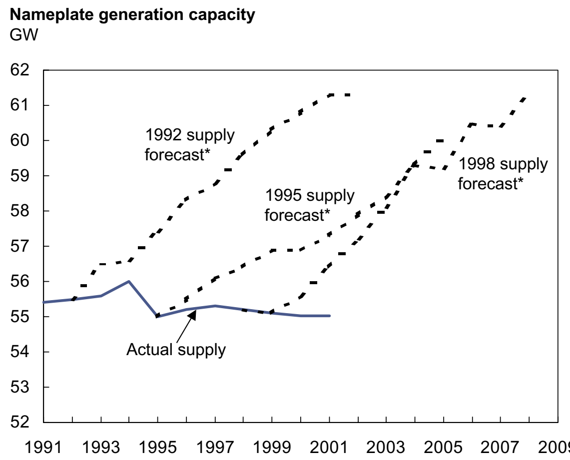
EXHIBIT 4B
CALIFORNIA RESERVE MARGIN DECEMEBER 2000 ESTIMATES



* Approximately 4 GW went offline in December due to insufficient emissions credits
Source: Press releases; CalSO; WSCC; NERC; FERC; RDI PowerDat; project team analysis

EXHIBIT 5
CALIFORNIA SUPPLY RESPONSE

ESTIMATES



Forecasted new supply was never constructed due to:

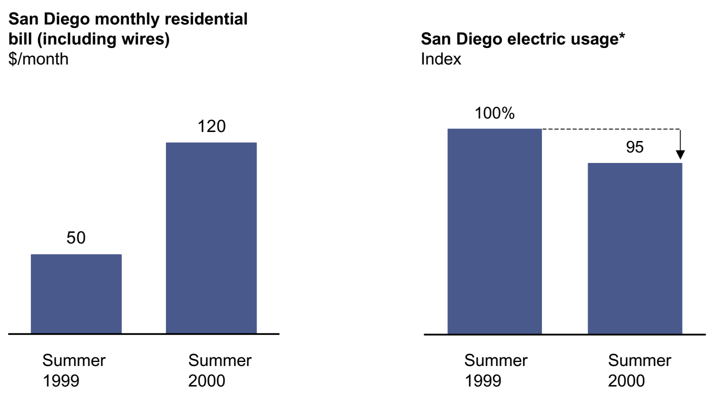
- High regulatory uncertainty
- Arduous permitting process
- No forward market to hedge price risks

* Estimates based on capacity forecasts for California/Mexico system and California/Nevada/Arizona system
Source: ERA; RDI PowerDat; NERC ES&D database; project team analysis

Further, demand for power did not adjust downward. Most consumers had their prices fixed and did not experience the price run-up plaguing the utilities. In short, neither a supply increase nor a significant demand decrease occurred; consequently, the price increase necessary to bring supply and demand into balance was enormous. In a few instances, balance could not be achieved at any price, leading to blackouts.

Interestingly, San Diego was an exception. There, the local utility, San Diego Gas and Electric (SDG&E), had paid off its stranded costs and retail price regulations were lifted in 1999. The company briefly passed on its wholesale prices to its customers last summer[8] and demand fell 5% from the previous year, despite warmer conditions. These prices were later capped by regulators. However, if repeated statewide, the 5% decrease in demand experienced in San Diego would have increased California's reserve margin from 6.8% to 11.6% during the Stage 3 emergency period that began in December (Exhibit 6). In other words, the state would not be facing blackouts if retail prices were allowed to adjust.

EXHIBIT 6A
DEMAND RESPONSE – SAN DIEGO EXAMPLE

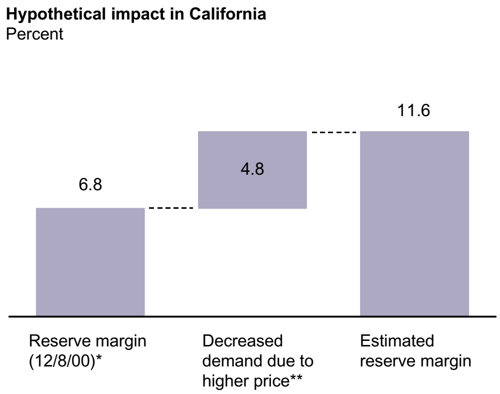


* Consumer response came 2 months after price increase
Source: The Sacramento Bee; CalSO; project team analysis

8 San Diego residential bills increased 140% in the summer of 2000 as compared to summer 1999.

EXHIBIT 6B

DEMAND RESPONSE – CALIFORNIA ESTIMATES



* Beginning of Stage 3 emergency due to 12 GW offline

** Based on observed demand elasticity in San Diego applied to California, assuming similar retail prices

Source: The Sacramento Bee; CalSO; project team analysis

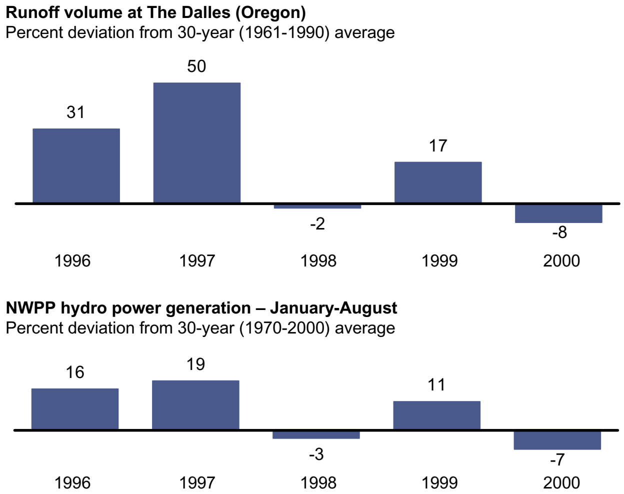
WHY WERE THE FORECASTS WRONG

A number of factors explain the supply-demand imbalance last year. While some were one-time events, many are likely to recur in 2001 and beyond.

- Lack of rainfall in the West resulted in hydroelectric power output in summer 2000 that was down 28% from 1999 levels (Exhibit 7). Forecasts for 2001 also predict a dry year.
- Higher-than-usual summer temperatures (June average of 65 degrees in 1998 versus 73 degrees in 2000) increased demand for electricity for air conditioning (Exhibit 8).
- Unscheduled outages in the summer and fall at a number of thermal plants reduced available supply (Exhibit 9). This was the result of high usage and deferred maintenance during the spring and early summer.
- Serious gas infrastructure constraints drove gas prices well above those in the rest of the country (Exhibits 10 and 11). Gas pipeline bottlenecks within California have constrained gas flow from Southern to Northern California (Exhibit 12), resulting in higher prices. Electric transmission bottlenecks within the state also aggravated local supply shortages late last year, particularly in Northern California, by limiting South-to-North transmission (Exhibit 13).
- Poor coordination of maintenance schedules (particularly at nuclear power plants) aggravated the fall supply shortage when nearly 5 gigawatts of generating power was taken off-line simultaneously.[9]
- Price caps imposed last summer actually made the tight supply problem worse by driving imports out of the state. The caps, combined with reduced output from out-of-state hydro, reduced imported energy from June to September of last year to less than half of 1999 levels (Exhibit 14).

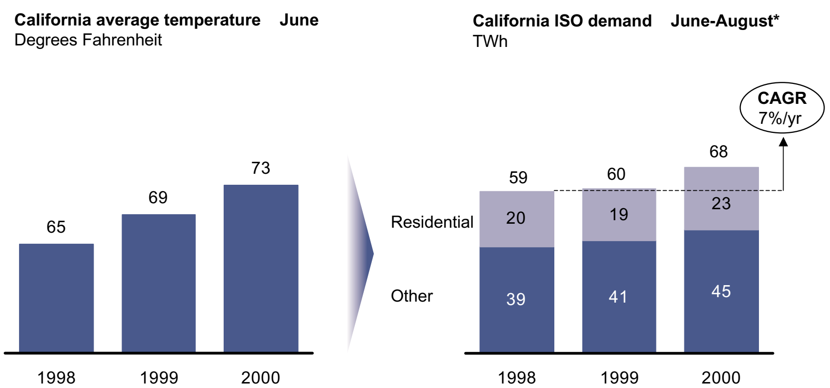
9 In some deregulated markets, generators are penalized if facilities are offline for more than a specified number of days.

EXHIBIT 7
RUNOFF VOLUME AND PACIFIC NORTHWEST HYDRO GENERATION



Source: RDI base case; Bonneville Power Administration; Cal ISO; project team analysis

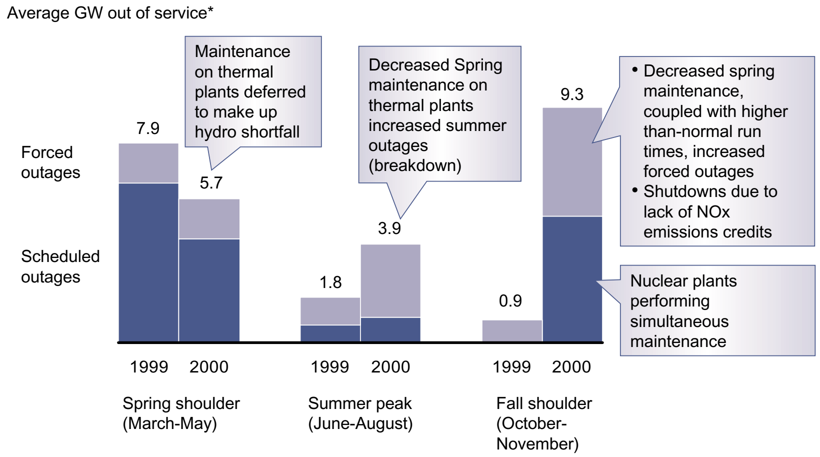
EXHIBIT 8
SUMMER TEMPERATURES AND ELECTRIC DEMAND



* Independent System Operator
Source: EIA; Electric Power Monthly; National Oceanic Atmospheric Administration; FERC staff report, November 2000; project team analysis

EXHIBIT 9

FORCED AND SCHEDULED OUTAGES AT THERMAL PLANTS

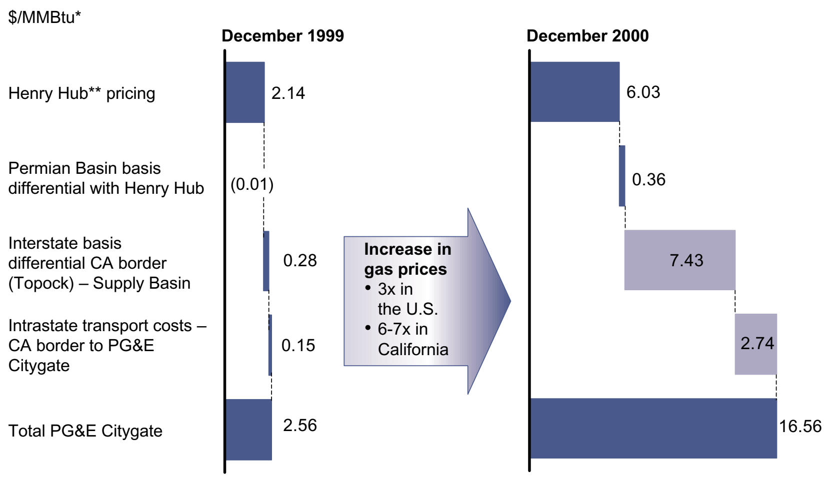


* Includes merchant and utilities generation

Source: Staff Report to the FERC on Western Markets and the Causes of the Summer 2000 Price Abnormalities, November 2000; California ISO Market Analysis Report, December 2000

EXHIBIT 10A

NATURAL GAS PRICES



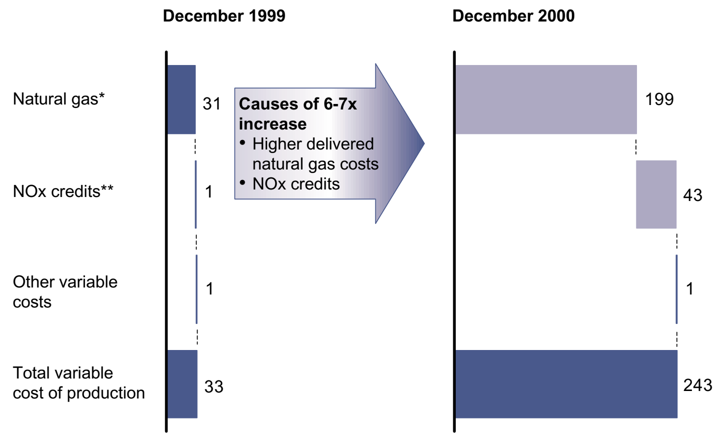
* Prices are volume-weighted, monthly average index prices

** Henry Hub is the recognized benchmark price for natural gas trading in the U.S. (located on the U.S. Gulf Coast)

Source: DRI; Western Natural Gas Market Review; Natural Gas Week

EXHIBIT 10B

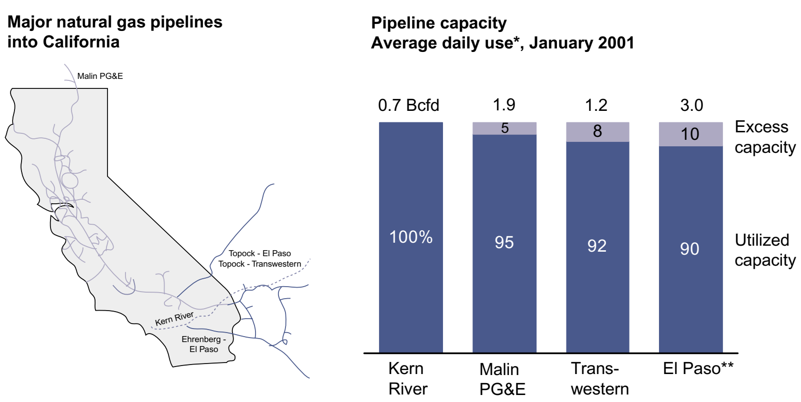
VARIABLE PRODUCTION COSTS FOR TYPICAL MARGINAL GAS UNIT
12,000 Btu/kWh simple cycle gas unit
$/MWh



* Calculated at $2.56/MMBtu on 12/99 and $16.56/MMBtu on 12/00
** Represents typical values for 2000 vintage NOx RTC credits, $1/lb in 12/99 and $46/lb in 12/00
Source: DRI; Western Natural Gas Market Review; CalISO; EPA; project team analysis

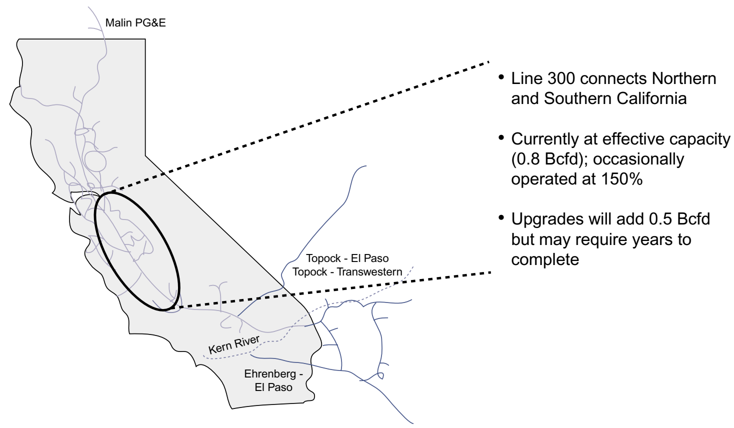
EXHIBIT 11

CONSTRAINTS IN GAS DELIVERY INFRASTRUCTURE



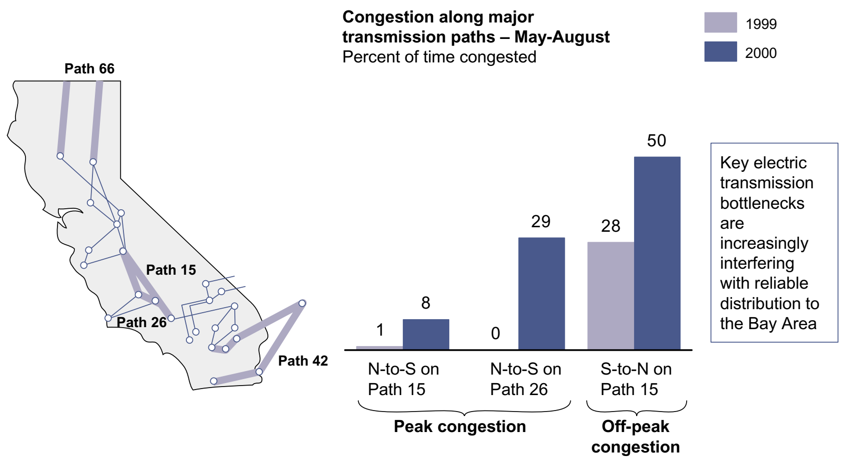
* Daily flows compared with maximum historical utilization
** The El Paso supply is piped into the state at 2 points: Topock and Ehrenberg
Source: RDI PowerMap; Energy Information Administration; Brent -Friedenberg Associates Western Power Review; project team analysis

EXHIBIT 12
BAY AREA GAS SUPPLY CONSTRAINED BY LINE 300



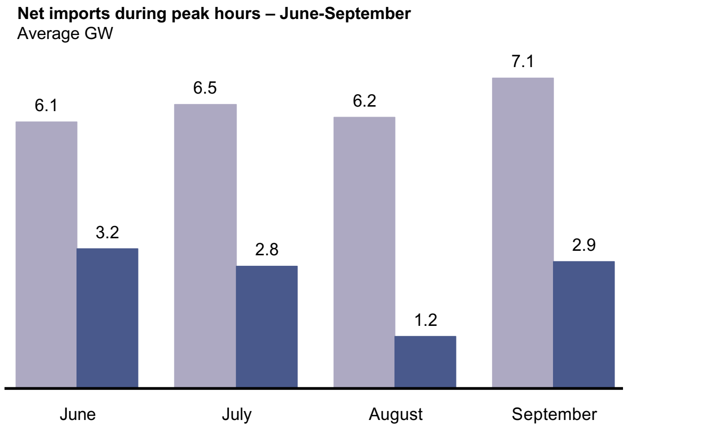
Source: 1998 California Gas Report; industry interviews; project team analysis

EXHIBIT 13
CONGESTION ON ELECTRIC TRANSMISSION PATHS WITHIN CALIFORNIA



Source: Staff Report to the FERC on Western Markets and the Causes of the Summer 2000 Price Abnormalities, November 2000; project team analyses

EXHIBIT 14
IMPORTS INTO CALIFORNIA



Source: CalSO market analysis report, December 2000

WHAT ROLE DID CALIFORNIA'S DEREGULATED MARKET STRUCTURE PLAY

Flawed market structure contributed to the current market power imbalances (Exhibit 15). Electricity is openly auctioned several times each day and a wealth of real-time information is available to all parties. Generators and marketers are very sophisticated market participants. In the iterative bidding process, they have learned in which market to sell and how high to bid in order to maximize their profits;[10] thus, they take full advantage of any market flaws that may work in their favor. While there is no evidence that generators and marketers did anything other than try to make the most money within the limits of the rules,[11] fundamental structural flaws may have amplified or exacerbated the advantage that sellers naturally possess when supplies are tight. The areas where the market design needs to be corrected are as follows:

- California deregulated the wholesale market while initially not permitting real competition on the retail side, at least until the end of 2002. Until recently, utilities under deregulation have been required to procure all power in the spot markets. This left them in a high-risk position, having long-term, fixed-price obligations to deliver energy to consumers, but no equivalent long-term supply contracts (Appendix A1). Not only did this leave the utilities at the mercy of generators and marketers who set the price,[12] it created another obstacle to the addition of new capacity. The utilities were the only players with a vested economic interest in maintaining healthy reserve margins (which would keep prices down by keeping supplies up), but they could not enter into long-term procurement contracts to entice investors to build new plants.[13]

10 A unit of power can be sold in a number of spot markets, including the day ahead, day of, and real-time, as well as a number of ancillary services markets. There are as many as 10 spot markets into which a unit of power may be sold and ultimately delivered.

11 Recent FERC investigations have not identified any wrongdoing; rather they only suggested that some January transactions appear to be overpriced (i.e., not explained by inherent costs). The refund ordered, $69 million, is relatively small compared to the total value of the transactions.

12 Many power plants, particularly the least efficient plants, only operate a fraction of the time. Specifically, they only produce power when prices are expected to be higher than the cost of generating electricity. This occurs at times of high demand relative to available supply. It is generally expected that these high prices will exist, and these plants will operate, at times of peak system load (e.g., summer afternoons); however, these plants may also operate in response to high prices for other reasons, such as a tight supply situation when lower cost power is unavailable (e.g., nuclear plant maintenance or refueling, reduced hydro-generated power).

- Regulatory uncertainties and bureaucratic roadblocks in California made it hard to build new generating capacity (Exhibits 16 and 17). Rules change frequently. Since the San Diego price run-up last summer, there have been more than 16 legislative bills, 35 additional legislative amendments, and a barrage of regulatory changes (Appendix A2); and the count continues to rise.

- While there does not appear to be strong market concentration by most traditional measures (the largest new player has less than 10% market share and the top four combined hold only about 25% market share), former utility-owned generation assets were acquired by only a handful of players (Exhibit 18). These buyers acquired both baseload and peaker assets (those high-cost plants that come on-line only when prices are really high, such as at peak times, and set prices). Thus, there was a potential concentration of power in the hands of a few key bidders in the very tight spot market. The utilities were required to sell off 50% of their gas-fired generating assets, but opted to sell all of them.

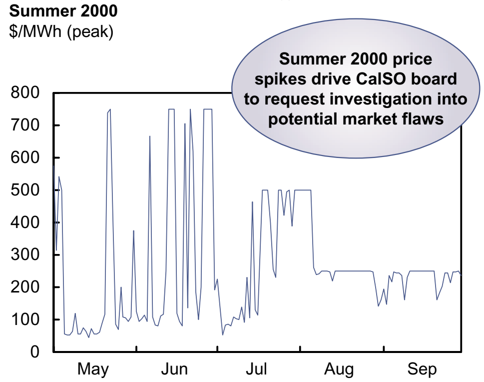
- As extreme price spikes were observed at peak hours, California imposed wholesale price caps. The caps were well intended, but actually made the situation worse. Acting as a price signal, the caps actually increased average peak hour generator margins since everyone bid up to the highest price regularly (Exhibit 19). Specifically, when the cap was reduced from $750/MWh to $500/MWh, average peak generator margins actually increased 11% (Exhibit 20). The lowest cap imposed, $250/MWh, did reduce average generator margins, but had the unintended consequence of driving imports during peak hours out of the state. During the month of August, prices available out of state[14] were $17/MWh to $58/MWh higher than those available in California. As a result, average peak hour imports in August with a $250/MWh cap were half the average levels that existed in June under a $750/MWh cap (Exhibit 21). This made the supply-demand imbalance worse.

These market flaws are important, and should be addressed. However, it is worthwhile to bear in mind that none would likely have been significant had reserve margins been kept at adequate levels. In fact, had last summer been cooler, had there been more rain in the Pacific Northwest, and had natural gas prices held at historical levels, the California power market might still be hailed as a tremendous success story, with most of the structural flaws and infrastructure limitations remaining for the time being undiscovered.

13 Nor could the utilities build new plants on their own.
14 Examples include: Palo Verde, Mead Nevada, and Four Corners.

EXHIBIT 15
MANY ACADEMICS AND OFFICIALS SUGGEST PRICE INCREASES WERE EXACERBATED BY DESIGN FLAWS

Electricity prices in real-time energy market – Summer 2000
$/MWh (peak)



"Market design flaws have enhanced market power in the real-time and ancillary service markets"
– Frank Wolak, Stanford

"Limits on formal contracting enhanced the ability of generation owners to exercise market power"
– CalSO

"There remains a price gap attributable to market power and related market imperfections"
– Paul Joskow, MIT

Source: CalSO Market Surveillance Committee Report, June 2000; Joskow Report on Wholesale Electricity Markets, Summer 2000

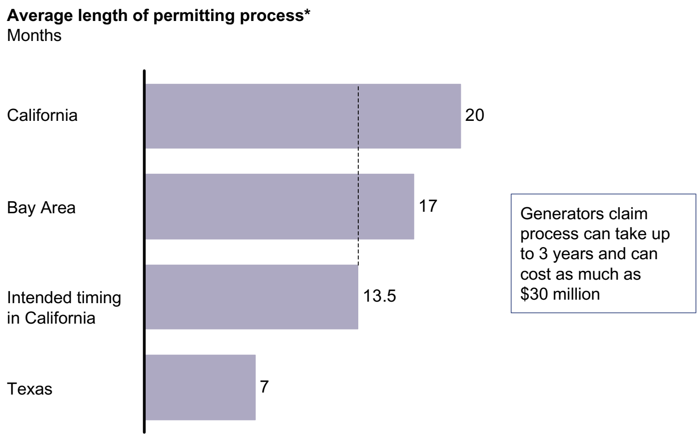
EXHIBIT 16
CALIFORNIA POWER PLANT PERMITTING PROCESS

Application for certification (through the CEC)

	Data adequacy	Discovery	Analysis	Formal hearings	Decision	
Key activities	• Workshops • Decision on data adequacy	• Site visits • Data requests • Workshops	• Staff assessment • Pre-hearing • Workshops	• Committee formal hearings • Party briefs	• Proposed decision • Final decision	
Intended timing Months	1.5	4	3	3	2	**= 13.5 months**

Source: CEC; project team analysis

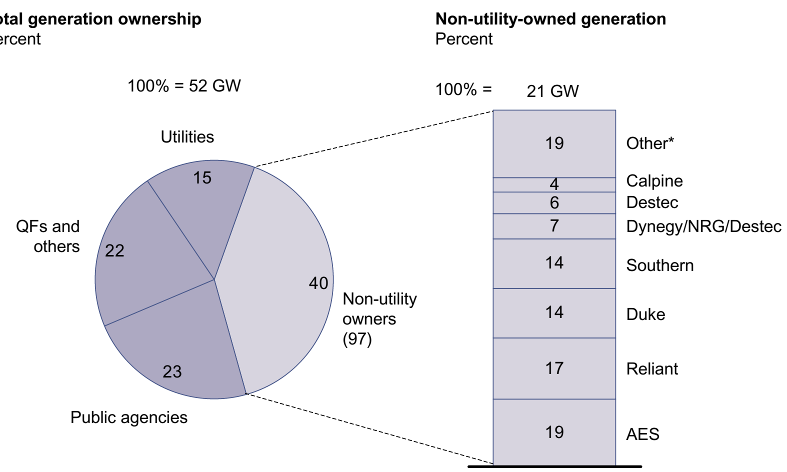
EXHIBIT 17
LENGTH OF CALIFORNIA POWER PLANT PERMITTING PROCESS



* California figures based on power plant proposals submitted during 1994-2000; Texas figures based on proposals submitted during 1999-2000

Source: CEC; Texas Natural Resources Conservation Commission; literature search

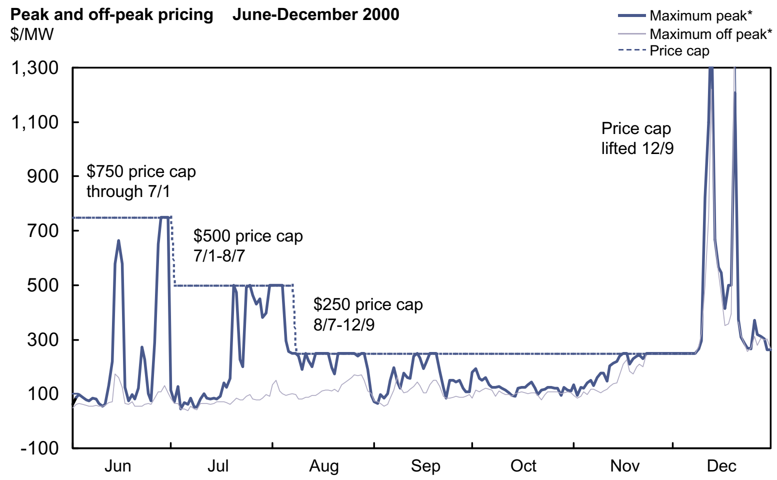
EXHIBIT 18
GENERATION OWNERSHIP IN CALIFORNIA



* Other includes 90 companies

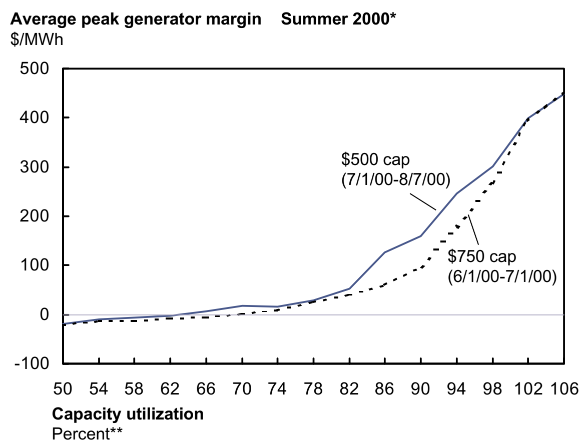
Source: CEC August 2000 Report to the Governor; RDI data; project team analysis

EXHIBIT 19
MARKET SIGNALS THROUGH PRICE CAPS



* Maximum hourly price for daily peak (7 a.m.-10 p.m.) and off peak (11 p.m.-6 a.m.) time periods
Source: Cantor Fitzgerald; RDI base case; California Power Exchange; project team analysis

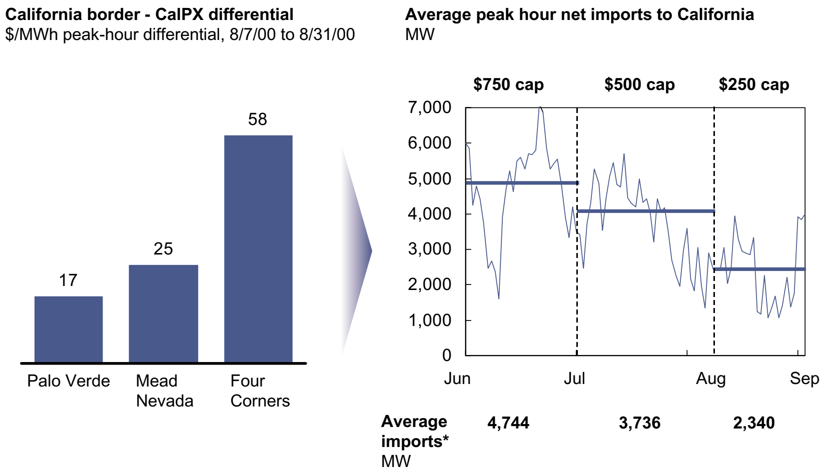
EXHIBIT 20
GENERATOR MARGINS UNDER $500 PRICE CAP



* Generator margin calculated for a 10,000 Btu/kWh gas turbine
** Capacity utilization calculated using CalSO load / (max supply bid during week in PX + max real-time imports into CalSO during week); capacity utilization over 100% spill over into CalSO real-time markets from CalPX day-ahead market
Source: CalSO; California Power Exchange; Cantor Fitzgerald; project team analysis

EXHIBIT 21

IMPORTS UNDER $250 PRICE CAP



* Reference to periods for price caps are 6/1/00-7/1/00, 7/1/00-8/7/00, and 8/7/00-9/1/00

Source: RDI base case; California Power Exchange; California ISO; *Megawatt Daily*; project team analysis

HOW IS THE NATURAL GAS CRISIS RELATED

While most attention is focused on electricity due to the blackout threat, California actually faces two shortages: natural gas and electricity. Natural gas is used directly, in heating units for example, and as a fuel to power electricity generators. Some of the increase in wholesale electricity prices is due to a dramatic increase in the cost of producing electricity for those generators. These producers are important as they are nearly always on the margin, setting price in California, since they are the most expensive (Appendix A3). From December 1999 to December 2000 the price of gas nearly tripled nationwide, but the price increased by a factor of six in California (Exhibit 10A), raising the cost of producing power similarly (Exhibit 10B). California prices are exceptionally high because pipelines bringing gas into the state are at capacity (Exhibit 11). Through October of last year, a 12% increase in demand for gas was driven by a 30% increase in the use of gas-fired electric generation, since output from other sources, particularly hydro, declined, and because California environmental regulations prevent gas-fired generators from switching to liquid fuels, in contrast to other states such as Texas and Florida (Appendix A4). The increase in the price of natural gas and other production costs (including NOx credits, or pollution "permit" costs[15]) explains one-third to one-half of the run-up in wholesale electricity prices in 2000 as compared to 1999.

The limitations in gas pipeline capacity complicate solutions to the energy crisis. At first glance, a solution to increasing electric supply in the state would be to build more gas-fired power plants. They are the quickest to construct, technologically advanced, and the most environmentally sound. However, means must then be found of getting the gas to fuel these plants into the state. Also, high levels of summer electric demand in 2000 resulted in natural gas being delivered to power plants that would otherwise have gone

15 A credit that authorizes a power plant to emit a volume of NOx, effectively a "right to pollute" that any fossil fuel power plant must have to operate in California. These credits can be bought and sold; the price of acquiring them goes up when demand for fossil fueled-power is very high.

into storage to meet the larger winter direct gas needs. Whereas in 1998, the gas injection period lasted 8 months, it was only 3 months long in 2000; consequently, peak storage volume has fallen 20% from 200 billion cubic feet to 160 Bcf (Appendix A5).[16] Current stored gas volumes are very low, and summer 2001 appears unlikely to afford an opportunity to return storage volumes to traditional levels, as the state will need all the gas-fired plants for electricity production. As a result, California faces not only an electricity crisis with significant risk of blackouts; it also faces a gas crisis with the risk of fully depleted storage late in 2001. When gas is in short supply, power plants are the first to have delivery curtailed, thus a winter gas shortage could mean more blackouts. There are currently no plans to significantly and rapidly expand pipeline capacity.

SUMMARY

The microeconomic analysis behind this section and analysis of the specifics of the California power market were conducted in order to understand the root causes of the current crisis. Analysis indicates that one-third to one-half of the run-up in wholesale power prices is explained by the increased costs of transporting and producing power in the state. By far the most critical factor in explaining the remainder of the extraordinary price increase is the fact that neither supply nor demand responded adequately to elevated prices. In addition, flawed market structures, and the market power that these structures may have passed to generators and marketers, contributed to the problem. It is the underlying imbalance, however, that needs to be urgently addressed.

California has an energy infrastructure problem. Long-term, it needs to build more power plants, and add significant gas and electric transmission capacity. Near-term solutions must employ a combination of actions aimed at rapidly increasing supply and curtailing demand – it is simply not possible to devise a solution using only supply options in the time available. Further, given the interconnectedness of the Western System Coordinating Council (WSCC) transmission system and resource sharing across the western states, western Canada, and Mexico, the impact of the crisis in the wholesale electric power market could potentially compromise the electric reliability of the western third of North America.

The next section will explore the specific impacts that the energy crisis will have on the Bay Area. The final section makes recommendations and proposes guidelines for potential solutions.

16 This actually understates the severity of the storage problem. For example, at the PG&E storage site in Northern California, total volume is 70 Bcf, though the first 40Bcf is generally not available for use, reducing the effective working volume to 30 Bcf.

HOW THE POWER CRISIS AFFECTS THE BAY AREA

Despite the size of the Bay Area economy – one of the 20 largest in the world if an independent country, and representing one-third of California's economic output[17] – it has expanded at an unprecedented average rate of 9% annually over the last five years (Exhibits 22 and 23). This compares to 6% for California and 4% for the U.S. as a whole. Yet the Bay Area has not been an energy hog. Economic output has grown nearly 7 percentage points faster than electricity consumption and 5 percentage points faster than natural gas consumption. By comparison, the state of California's economic output has grown 4 percentage points faster than electricity use.

The assumption that the "new economy," with businesses such as data centers or "server farms," is primarily responsible for the increase in energy consumption is simply not correct. For example, while the Computers and Electronics segment has expanded output at 21.7% per year, power consumption increased by only 6.3% per year (Appendix B1 through B4). In fact, the total increase in power consumption by the Computers and Electronics segment from 1995 to 1999 represents less than one-tenth of the increase in total power consumption throughout the Bay Area during the same period. Business sectors do dominate regional energy consumption, using 66% of electricity and 68% of natural gas, yet each of the Bay Area industry groupings exhibited a decline in energy intensity, the energy consumed per unit of output, from 1995 to 1999 (Exhibits 24, 25, and 26). Knowledge-based Industry Clusters (such as Computers and Electronics) saw their energy use per dollar of output drop by an average of 9% per year; even the energy intensity of the Traditional Industrial Base dropped 6% annually.

The Economic Forum has conducted a far-reaching survey of local businesses[18] that shows that those industries that have most contributed to the region's economic growth, such as the Knowledge-based Industry Clusters, are the most concerned and threatened by unreliable power (Exhibit 27). Later in this section, costs to economic growth from the power shortage are discussed in more detail; some scenarios suggest recession, or negative economic growth, is possible. Regardless of who is responsible for the state's energy crisis, the situation is a substantial threat to the Bay Area economy and thus dangerous for California and even the country.

17 Output is similar to revenue but calculated differently. For California and the U.S., output is based on GSP and GPO releases; industry-level gross product is calculated as the sum of wages, salary, and profits accruing to a particular industry; and county-level output is calculated by applying a state-to-county profit ratio within a particular industry to wage and salary data at the county level. Figures are stated in 1996 dollars for total non-farm output for 1999 (the most recent year for which accurate figures are available).

18 A Web-based survey of 512 Bay Area businesses, developed in conjunction with Alliance Research, Inc., was conducted March 19-26, 2001. The Bay Area Economic Forum and the Bay Area Council were assisted in this effort by the Silicon Valley Manufacturing Group (SVMG), the Economic Development Alliance for Business (EDAB), the San Francisco Chamber of Commerce, the San Jose Silicon Valley Chamber of Commerce, and the San Rafael Chamber of Commerce.

EXHIBIT 22
BAY AREA ECONOMIC GROUPINGS

Key Industry Groupings*

Knowledge-based Industry Clusters
- Biosciences
- Computers and Electronics
- Environmental Technology
- Multimedia
- Telecommunications
- Banking and Finance
- Tourism

Key Employment Sectors
- Business Services**
- Retail Trade
- Wholesale Trade

\+

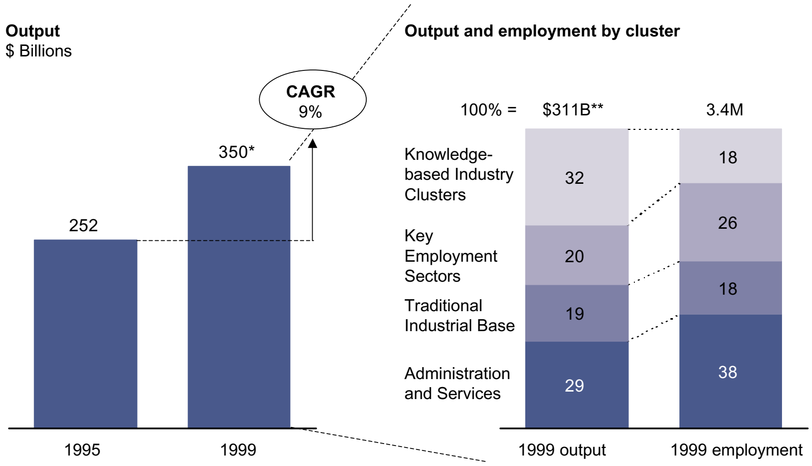
Other Industry Groupings

Traditional Industrial Base
- Construction, Transportation & Transportation Equipment
- Manufacturing - fabrication
- Manufacturing - refining, conversion, processing
- Resource Extraction

Administration and Services
- Public Administration
- Services***

* As identified in an earlier Bay Area Economic Forum and Bay Area Council report, "Winning in the New Global Economy," 1999
** Includes advertising, equipment rental and leasing, employment agencies, etc.
*** Includes legal services, health services, insurance, real estate, education services, and other miscellany

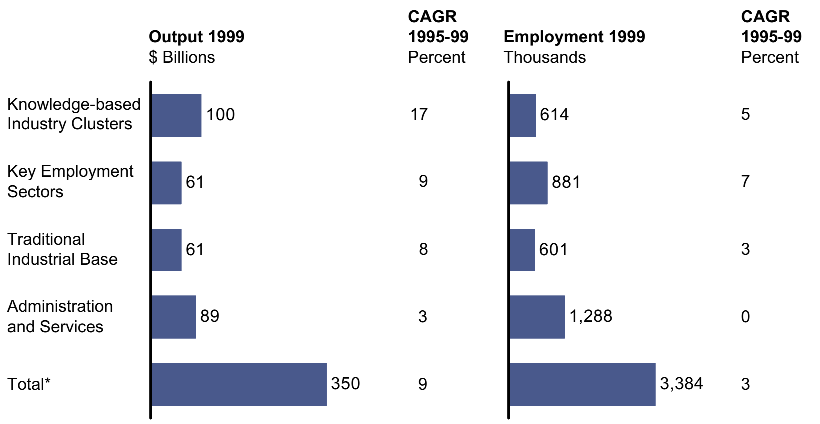
EXHIBIT 23
BAY AREA ECONOMIC GROWTH



* Based on a roll-up of Bay Area industries; margin of error with aggregate reported figures is ±3%
** Does not include owner-occupied housing services portion of gross product, which in 1999 accounted for $39 billion in output

Source: Economy.com; project team analysis

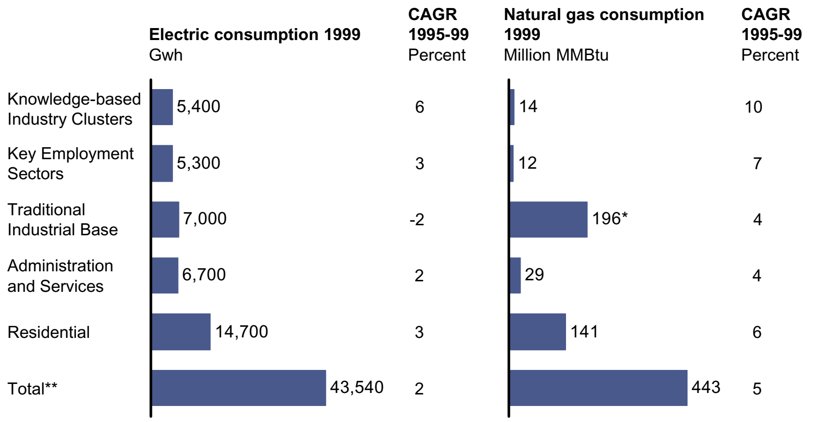
EXHIBIT 24
BAY AREA ECONOMIC PROFILE



* Includes owner-occupied housing services, which contributed $39 billion to output in 1999

Source: Economy.com; project team analysis

EXHIBIT 25
BAY AREA ENERGY CONSUMPTION



* Includes gas-fired power plants

** Includes unclassified non-residential customers that account for 4,380 GWh of electricity and 51 million MMBtu of gas

Source: PG&E; project team analysis

EXHIBIT 26

BAY AREA ENERGY INTENSITY

	Total energy consumption[1] 1999 GWh equivalent	CAGR 1995-99 Percent	Energy intensity[2] 1999 GWh equivalent/$ billions	CAGR 1995-99 Percent
Knowledge-based Industry Clusters	6,800	6	68	-9
Key Employment Sectors	6,400	4	105	-5
Traditional Industrial Base	26,700	2	437[3]	-6
Administration and Services[4]	9,700	3	108	-1
Residential	28,800	5	n/a	n/a
Total[5]	87,840	3	169	-6

1 Energy use calculated from electric and natural gas consumption by applying a conversion factor of 10,000 Btu per KWh
2 Energy use/output
3 Includes gas-fired power plants
4 Indicated figure is misleading since most of the industries in this group have very low energy intensity, with the exception of Real Estate, which raises the average considerably. Real Estate is not particularly energy-intensive but frequently pays utility bills on behalf of commercial tenants; in most cases, this is passed through to tenants as a variable component of rent
5 Excludes unclassified non-residential customers

Source: PG&E; project team analysis

EXHIBIT 27A

KEY CONCERNS ABOUT ENERGY CRISIS

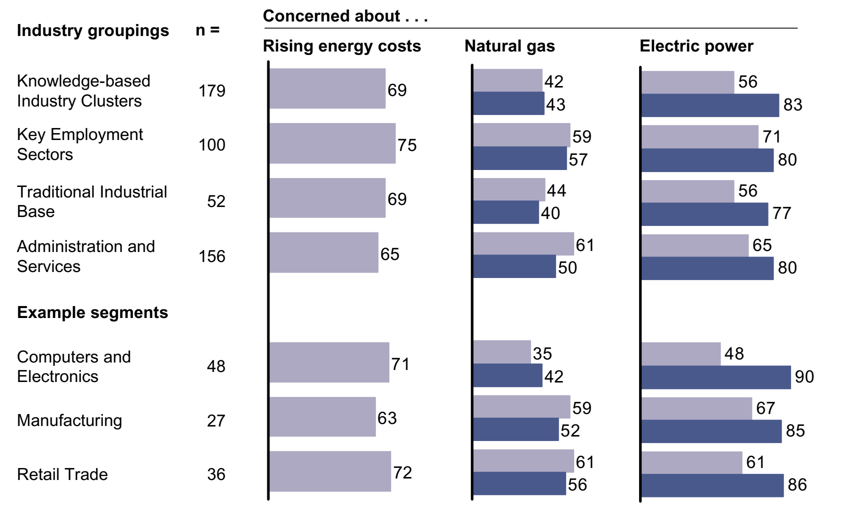
Percentage of survey respondents who agree or strongly agree; 100% = 512

	Percentage	Mean 1 = strongly disagree, 5 = strongly agree
Rising energy costs	86	4.4
Price of natural gas	75	4.2
Potential for gas curtailments	72	4.1
Price of electric power	89	4.5
Reliability of electric power	91	4.7

EXHIBIT 27B

KEY CONCERNS ABOUT ENERGY CRISIS BY CLUSTER

Percentage of survey respondents that strongly agree; 100% = 512

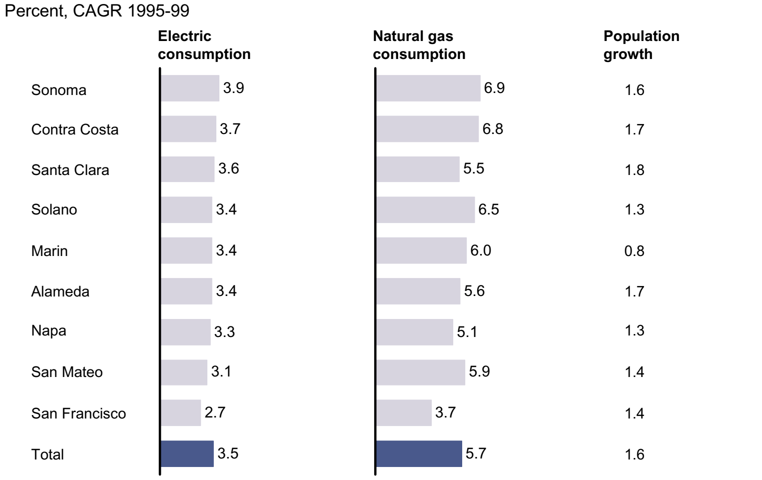


Overall, total Bay Area electric consumption has grown at an average rate of 2.3% per year, with residential consumption growth outpacing that of business (3.5% vs. 1.7%). Contrary to popular belief, residential consumption appears to have increased uniformly throughout the region and has not been dominated by wealthier districts (Exhibit 28). This fact, combined with usage increasing on average 2% faster than population growth, is a testament to an increased standard of living for the entire Bay Area population.[19] This standard of living and quality of life that has made the area so attractive to highly-educated workers and Knowledge-based Industry Clusters could also be threatened.

EXHIBIT 28

BAY AREA RESIDENTIAL ENERGY CONSUMPTION GROWTH

Percent, CAGR 1995-99



Source: RAND California

19 Increased residential consumption is largely driven by increasing wealth, while electricity rates generally remained constant or even decreased. In fact, average electric consumption may be growing slightly faster than the stated 3.5% growth rate as 1995 had 12% more degree cooling days than 1999, suggesting a greater need for air-conditioning in 1995 than 1999; absent this affect, the 3.5% average electric consumption growth rate might actually be higher. The gas consumption situation initially appears to contain a much greater wealth effect, but 1999 had 23% more degree heating days than 1995, suggesting a greater need for gas heat in 1999 than 1995; absent this affect, the 5.7% average annual growth in gas consumption would be somewhat lower, though still well above the population growth rate.

WHAT ARE THE PROBABLE EFFECTS

The energy crisis impacts business and residential consumers in three ways: higher electric prices, higher gas prices, and the potential for power outages or blackouts. Generally, everyone prefers low prices to high; they facilitate growth, improve cost competitiveness, and increase disposable income, which in turn stimulates growth through a virtuous cycle as this money is cycled back into the economy. However, businesses and residents place an extremely high value on reliability because of the broad set of costs blackouts impose.

The Costs to Business

In response to rising energy costs, businesses pass costs on to their customers, become more energy-efficient, or suffer reduced profits. In the short run, many businesses find it difficult to raise prices without adversely affecting sales. Consequently, businesses initially will either become less profitable or more efficient, usually through one or more of the following courses of action:

- Focus on energy efficiency, particularly in instances where energy is a critical input in a production process;
- Focus on basic energy conservation (i.e., reducing consumption), particularly in an office or commercial environment;
- Cut costs in other areas, such as materials or labor;
- Shift load to off-peak hours when lower electricity rates may be available; or
- Relocate to another geographic area in search of lower energy rates.

In extreme cases, businesses with access to low-cost power – for example, through a captive co-generation facility[20] or favorable power supply contracts – will decide to curtail operations in order to sell power back to the grid at the going price, if it is higher than their own cost. This has occurred at some aluminum smelters in the Pacific Northwest in recent months, idling nearly 3,000 workers. Power prices are so high and operating margins so thin that, even while continuing to compensate employees, it is more profitable to sell power than to make aluminum. In the Bay Area, only a few businesses (3% of survey respondents) have reported curtailing operations to sell power; although this figure may have been influenced downward by fears that the financially distressed utilities cannot pay for the energy anyway.

Blackouts impose a wide range of costs on the economy, but these costs are incredibly difficult to quantify. The primary costs are direct and roughly proportional to the duration of the outage and the amount of undelivered power, including lost production and idled labor. Frequently, however, actual losses are much greater than this. For example, when production systems are shutdown, it can take hours or days to restart them and return to full productivity. Often, information technology equipment and even

20 Some businesses, often those with large energy needs in the form of electricity or steam, build small power plants to serve their own needs. Occasionally, this plant is oversized to permit some excess sales to the system grid.

basic manufacturing equipment is damaged when power is suddenly lost; and industries dependent on climate control (from bioscience labs to supermarkets) are threatened with damaged research or spoiled goods. Finally, power interruptions frequently result in lost data, which can be costly and sometimes impossible to reproduce.

Loss of power can also impose longer-term costs by damaging external relationships and customer interactions. For example, a power interruption for an Internet-based business can compromise security and harm its reputation, leading to lower sales in the future. Internet-based businesses as well as other Knowledge-based Industry Clusters are disproportionately important to the growth of the local economy, having grown at average rates of 17% per year since 1995 (Exhibit 24). For a brick-and-mortar business, inadequate lighting and lack of power to security systems increase the potential likelihood of vandalism and theft. Loss of climate control and telecommunications capabilities makes it especially difficult for restaurants and retail establishments to attract and retain customers. However, all of these factors still only point to direct costs. Indirect costs multiply the impact several times over as the effects of a power interruption ripple through the economy; for example, lost sales by a retailer can lead to reduced orders to suppliers and so forth.

Costs to Residential Consumers

Understanding the impact on residential consumers is a bit more straightforward. Each additional dollar spent on energy is one not spent on something else, and consumer demand is critical to the health of the economy. Faced with higher prices, a residential user can either conserve energy or skimp elsewhere. Research shows that rate increases result in some conservation, although usually not enough to keep total energy expenditure at a fixed level (Appendix B5).

For residential users, blackouts are largely a matter of inconvenience. Nonetheless, research indicates that consumers place a very high value on service reliability. A respected PG&E study suggests that when confronted with the possibility of a one-hour power outage on a summer afternoon, residents would pay between $2.87 and $3.97 per kWh[21] for the undelivered power, or about 30 times the actual price of the power had it been available (Exhibit 29).[22] Consistent figures are seen in other markets. For example, in the UK, value of lost power to residential consumers was built into the recently revised electricity price and set at $3.09/kWh. For commercial and industrial users, the figures are naturally much higher, with PG&E estimates ranging between $38 to $53, and $11 to $19, respectively.

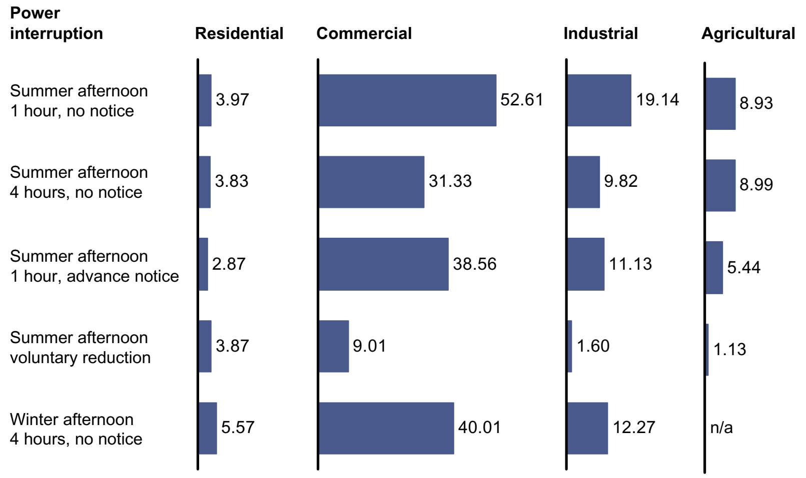
21 Range depends on the length of the outage and whether or not advance notice was provided.

22 "Value of Service Studies," presented to ISO Grid Planning Standards Subcommittee, February 8, 2000. Value of service refers to the direct cost of a blackout to the end-user. Results from the PG&E study were compiled from a survey pool of residential, commercial, and industrial customers, and averaged to provide value of service figures.

EXHIBIT 29

VALUE OF SERVICE ESTIMATES

Dollars (1993) per KWh unserved



* Residential figures based on a random sample of 1,000 customers, commercial figures based on a random, stratified sample of 1,200 customer premises

Source: PG&E Value of Service Studies, February 8, 2000

Blackouts are both inefficient and indiscriminate – they affect wealthy and poor, healthy and infirm, young and old, equally. As a result, a power interruption can lead to a number of social ills, such as compromised fire and police protection, lack of proper sewage treatment, and, in some cases, shuttering of health services. Fortunately, a rolling blackout, as is typical of the current energy crisis, puts most critical operations on a protected grid, generally preventing blackouts to them.[23] However, there are exceptions. For example, during the recent rolling blackouts on March 19 and 20, the Regional Medical Center of San Jose, with about 200 beds, was included in the outages by mistake.[24] When outages affect such a wide geographic area, critical errors are difficult to prevent and can result in losses that are impossible to value in dollar terms.

ECONOMIC IMPACT OF HIGHER PRICES

Higher energy prices naturally increase costs for everyone. Forty-two percent of local businesses surveyed agreed that the energy crisis has already lowered their profit margins, as well as their competitiveness relative to peers outside the area (Exhibit 30; Appendix B6). However, only 15% of all businesses indicated that they have passed higher energy costs on to customers. Most businesses have either taken steps to reduce energy consumption or cut costs in other areas. In fact, 96% of respondents have reduced energy consumption, with most cutting back 5-15% on electricity and less than 5% on natural gas (Exhibit 31; Appendix B7). Of those that have reduced energy consumption, 89% have reduced lighting and 67% have changed their thermostat levels. All of these figures are remarkably high given that most companies had not yet experienced elevated electricity prices at the time of the survey.

23 PG&E's service area is divided into 14 blocks, each of which represents 550 MW of electric load. During a rolling blackout, PG&E cuts power to each block in sequence for 60-90 minutes. Block 50 refers to electrical circuits with a hospital, police station or other critical service, and is exempt from rolling blackouts.

24 Hospitals with more than 100 beds are intended to be exempt from rolling blackouts.

Elevated energy costs present a significant drag on the economy and can be expected to reduce growth in economic output and employment. According to an internal Washington State[25] government report, without conservation and supply-side initiatives, the energy crisis will reduce forecasted economic output growth from 2.0% to 1.5%, and will result in the creation of 43,000 fewer jobs over the next three years.[26] The Bay Area economy is less energy-intensive than that of the state of Washington, which retains a large number of energy-intensive natural resource-based industries. Nonetheless, a 50% increase in commercial and industrial rates would result in more than a half billion dollars in lost output to the Bay Area annually, retarding overall growth by about 0.2% per year and resulting in the creation of about 15,000 fewer jobs over the next three years (Exhibits 32 and 33; Appendix B8). These are significant figures and matters for real concern, but probably manageable for the Bay Area economy. It is worth bearing in mind that the broad national, and indeed global, economy has endured larger increases in total energy costs as oil prices have risen on a number of occasions in the past.

With this in mind, and realizing that most businesses have been somewhat affected by higher energy prices, there are a number of industries that are more energy-intensive and thus are more vulnerable to price increases. This includes three Knowledge-based Industries (Biosciences, Environmental Technology, and Tourism), Retail Trade, Manufacturing[27] and Resource Extraction. All told, this group represents 25% of total Bay Area economic output and 29% of employment (968,000 jobs) (Exhibit 34; Appendix B1 through B4).

Understanding the impact of higher energy costs on these sectors first requires a look at their ability to pass on costs to customers and their capacity to conserve in the short-term. The combination of these two filters identifies industry segments that are not only energy-intensive, but also exceedingly rate-sensitive. Rate-sensitive segments include: Biosciences, Environmental Technology, Manufacturing, and Resource Extraction (Exhibit 35). Together, these five segments still represent 14% of Bay Area economic output and 10% of employment (351,000 jobs).[28]

25 Washington State is an excellent example of the impact of high energy costs as it is already feeling the impact of higher prices brought on by the situation in California, but has little risk of blackouts.

26 Based on an internal agency analysis on the effects of the energy crisis on the Washington state economy, conducted by the Washington State Office of Financial Management in March 2001. The OFM estimates that almost half of the reduction in job growth would come from energy or water-dependent export industries.

27 Including fabrication as well as refining and processing.

28 Employment refers to total non-farm employment for the entire Bay Area.

EXHIBIT 30

IMPACT OF ENERGY CRISIS

Percentage of survey respondents; 100% = 512

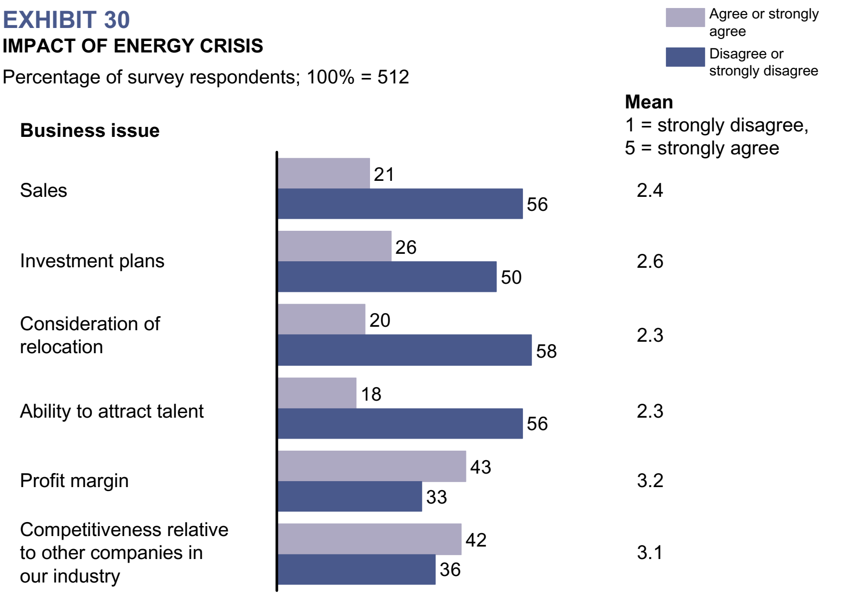
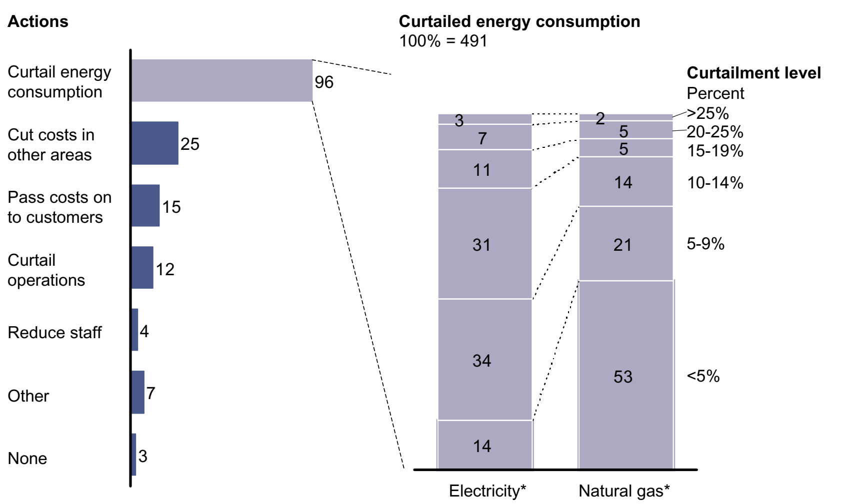


EXHIBIT 31

ACTIONS TAKEN IN RESPONSE TO HIGHER ENERGY COSTS

Percentage of survey respondents; 100% = 512



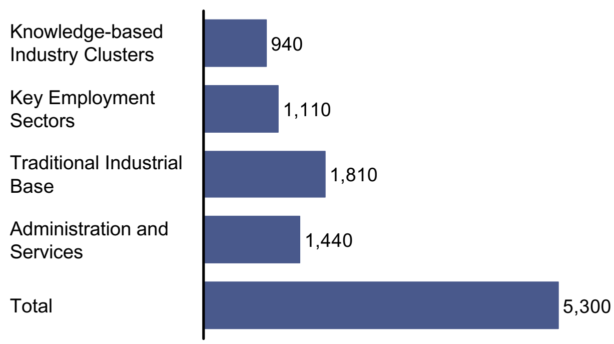
* Does not include those who did not answer (<1%)

EXHIBIT 32
BAY AREA IMPACT OF A 50% BUSINESS RATE INCREASE

	Estimated percentage conserved	Estimated percentage of cost passed on to customer	Estimated decrease in Annual output $ Millions	Estimated decrease in Growth Percent
Knowledge-based Industry Clusters	8-12	25-30	150	0.15
Key Employment Sectors	10-15	60-70	80	0.12
Traditional Industrial Base	5-10	25-30	210	0.35
Administration and Services	10-15	60-70	100	0.11
Total	8-12	40-50	530	0.17

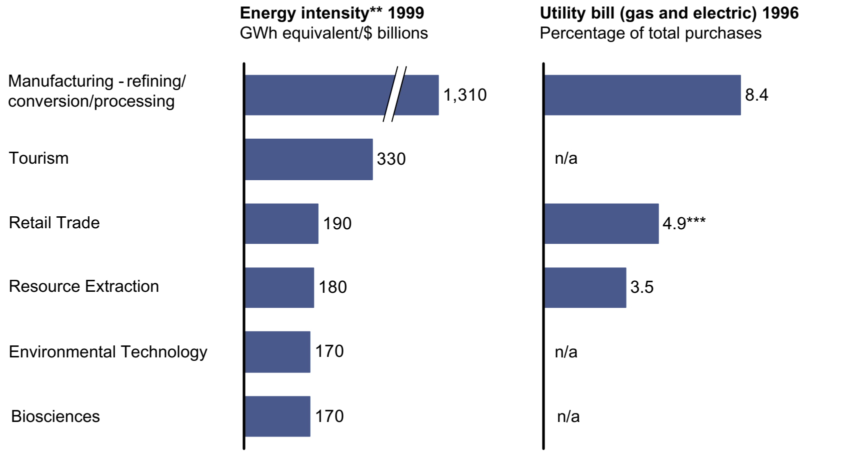
Source: PG&E; industry interviews; project team analysis

EXHIBIT 33
ESTIMATED BAY AREA JOB LOSS DUE TO A 50% BUSINESS RATE INCREASE



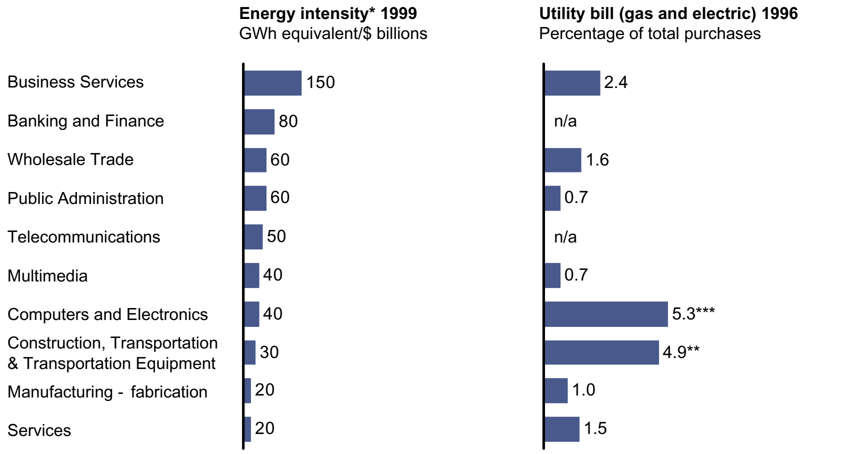
Source: PG&E; industry interviews; project team analysis

EXHIBIT 34A
ENERGY-INTENSIVE BAY AREA INDUSTRIES*



* Defined as those clusters with above-average energy intensity (170 GWh equivalent/$ billions)
** Energy use/output; energy calculated from electricity and natural gas use, using a conversion factor of 10,000 Btu per kWh
*** Data taken from a combination of Wholesale and Retail Trade; team analysis indicates that retail spends more on utilities
Source: PG&E; Bear, Stearns & Co.; Economy.com; project team analysis

EXHIBIT 34B
LESS ENERGY-INTENSIVE BAY AREA INDUSTRIES



* Energy use/output; energy calculated from electricity and natural gas use, using a conversion factor of 10,000 Btu/KWh
** Data based on Wholesale and Retail Trade; analysis indicates that retail spends more on utilities
*** Operating structure involves high payroll expenses relative to total purchases, explaining the 5%
Source: PG&E; Bear, Stearns & Co.; Economy.com; project team analysis

EXHIBIT 35

RATE SENSITIVITY MATRIX

Energy intensity \ Ability to pass on costs	Moderate	Difficult
High	• Retail Trade • Tourism	• Environmental Technology • Biosciences • Manufacturing - refining/ conversion/processing • Resource Extraction
Low	• Banking and Finance • Business Services • Services	• Computers and Electronics • Construction, Transportation & Transportation Equipment • Manufacturing - fabrication • Multimedia • Public Administration • Telecommunications • Wholesale Trade

Legend: Very high (shaded: High energy intensity / Difficult); Moderate or low (unshaded)

Highly Rate-Sensitive Businesses

Biosciences and Environmental Technology are typically unable to pass on increased costs as most of these companies participate in international markets, with a range of competitors located outside the state. Additionally, for some Bioscience companies, research projects are funded on fixed-price contracts that do not take into account variable costs like energy. These two segments are relatively small in terms of total output (5%) and employment (2% or 54,000 jobs); however, they do have strong growth prospects and are expected to help fuel the economy in the future. As a result, concerns about the long-term competitiveness of these sectors are more significant than immediate concerns about the impact of these sectors on the broader Bay Area economy.

Manufacturing and Resource Extraction are similar. Margins are typically modest, and businesses in this sector generally compete in regional, national, or even global markets that make it very difficult to pass costs on to customers without significantly and adversely impacting sales. Given a 50% increase in electricity costs for businesses (the figure currently being discussed as potentially necessary), about 5-30% could be recovered, either through conservation or cutting costs in other areas (Appendix B9). Up to 35% of the balance of the cost increase could be passed on to their customers. The remainder would likely reduce profit margins and therefore also reduce total economic output growth. These sectors currently represent 12% of output and 9% of employment (296,000 jobs). A rate hike of this magnitude could reduce the rate of output growth of these segments by nearly 0.5% annually – a matter of serious concern.

Less Rate-Sensitive Businesses

Of the energy-intensive segments, Tourism and Retail Trade are most able to pass on higher energy costs to customers, and thus are less rate-sensitive.

Tourism is energy-intensive and is responsible for 2% of Bay Area output and 3% of employment (103,000 jobs). This segment is able to pass through most of the higher energy costs, as its customers are not particularly price-sensitive. As an example, Bay Area hotels have already added a significant energy surcharge to guest bills.[29] The San Francisco Convention and Visitors Bureau observes that most convention customers are generally not price-sensitive, and that despite spotted inquiries from out-of-state residents about power reliability, it has no records of visits or conventions being cancelled due to concerns about the energy crisis. Over a longer period of time, however, this sector may have more difficulty passing on costs as it directly competes with a host of other cities around the country.

Retail Trade is somewhat unique. While energy-intensive, much of this energy consumption is based on customer service needs. Brighter interior lights, air conditioning, and prominent exterior lighting serve to attract customers, improve their experience, and thus increase sales. Therefore, some conservation efforts may have the unintended impact of reducing revenue as well as decreasing costs. But the situation is more complicated. Retailers often have low margins and cannot just "eat" the higher costs. Fortunately, there are a couple of mitigating forces. Most retailers' direct competition is local and faces the same higher energy costs. And the lowest-margin retailers, such as grocers, tend to have the most stable sales volume since it takes a lot of economic distress to get people to stop eating. The response of retailers to this crisis will be very important to the economy since the nature of employment in this sector has historically led to rapid downsizing during economic downturns. The Retail Trade workforce comprises 15% of Bay Area employment (514,000 jobs).

Most of the remaining segments are not especially energy-intensive.[30] This includes Banking and Finance, Computers and Electronics, Multimedia, Telecommunications, Business Services, and Wholesale Trade; Construction, Transportation, and Transportation Equipment; and Public Administration and Services. For the most part, these segments reflect office-style commercial environments or production processes with relatively modest gas and electric requirements.[31] In a typical office or commercial environment, energy represents only about 1-2% of total costs. Hence a 50% increase in energy cost, while not insignificant, still leaves total energy cost as a fairly small line item.

ECONOMIC IMPACT OF BLACKOUTS

Although higher prices present a significant risk to the Bay Area economy, the lack of a reliable power supply is a much more serious threat, particularly for the high-growth sectors responsible for the area's economic success. Fifty-six percent of respondents from

29 Surcharges range from $2 to $10 per night at some hotels.

30 Exceptions abound within any given segment. For example, data centers, a part of the Computers and Electronics segment, are more energy-intensive than a typical commercial environment, particularly when consumption is evaluated per square foot of commercial space. It is worth noting though that data centers still are not as energy-intensive as many industrial settings, particularly relative to economic output.

31 Construction is an energy-intensive segment, but relies more on liquid fuels than on gas and electricity.

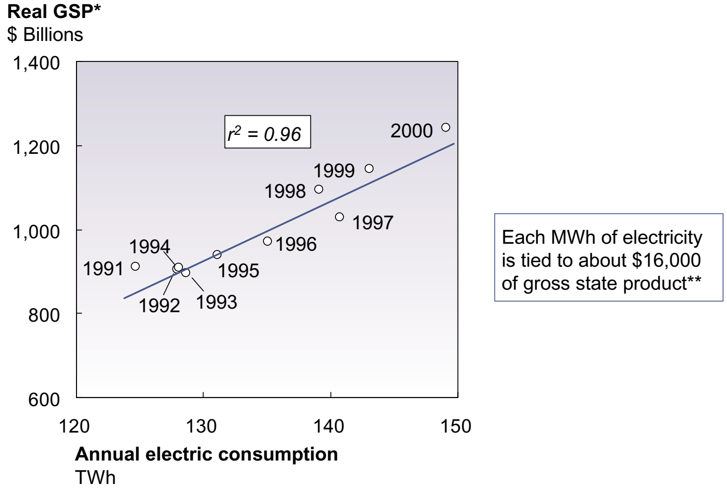
knowledge-intensive sectors indicated that they are highly concerned about the price of electric power, but fully 83 percent are highly concerned about its reliability (Exhibit 27B).

Each megawatt hour (MWh) of power that goes undelivered represents about $16,000 of lost California economic output (Exhibit 36). This is a simple means of estimating the economic cost of a blackout and puts the potential impact into perspective. For example, on March 19-20, 2001, the total load that went unserved was about 5,000 MWh, which represents about $75 million-100 million of lost output for the state. These rolling blackouts affected 1.2 million-1.8 million residential and business customers across California; value of service research suggests that these customers place $150 million-200 million of value on this lost service (Exhibits 37 and 38).

CaISO projections for this summer suggest that, at peak hours, statewide demand could exceed supply by as much as 3,600 MW.[32] Given this shortfall and historical daily energy usage patterns, total lost output statewide from June to September could range from $2 billion-16 billion (Exhibit 39).[33] This translates into a reduction in the annual state growth rate, currently forecast at 3.5%, of anywhere from 0.15% to greater than 1%. Should the CaISO projections prove to be optimistic (for example, if temperatures are higher, or less capacity comes online than planned) the economic impact of the resulting blackouts could increase by a factor of two to four, sufficient to push California into recession.

EXHIBIT 36

CALIFORNIA GROSS PRODUCT VS. ELECTRICITY CONSUMPTION



* Gross state product as stated in 1996 dollars; includes commercial and industrial consumption

** Stated in current dollars

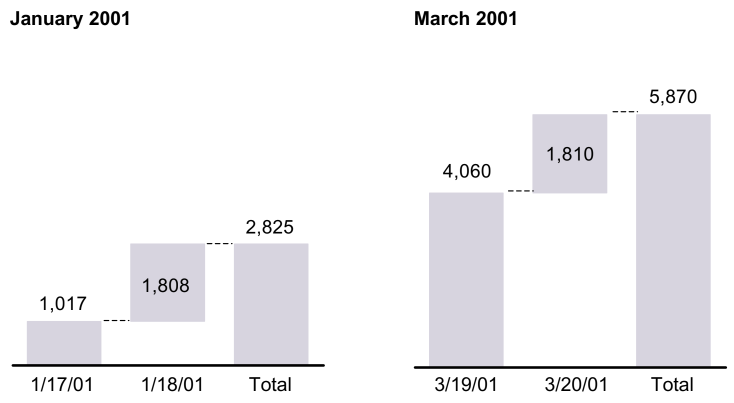
Source: California Technology; Trade and Commerce Agency; CEC; Economagic; project team analysis

32 "CaISO 2001 Summer Assessment," March 22, 2001. Projections are considered optimistic. First, unplanned outages are forecasted at 2,500 MW for each month this summer, whereas last year, unplanned outages were approximately 7,000 MW at summer peak and as high as 12,000 MW in the winter. Second, forecasts are dependent on significant amounts of additional capacity coming online during the course of the summer, the net effect of which is complicated by the fact that planned maintenance of many thermal units has been postponed or cut short in anticipation, raising the likelihood of plant failures. Third, projections are based on a baseline average for summer temperatures; adjusting figures from average to hotter, "once-in-ten-year" temperatures would yield substantially higher shortage estimates. Finally, the ISO assumes required net imports of 9,400 MW during peak hours in June, with a forecasted shortfall of 6,000 MW. Given dry conditions in the Northwest, it is possible that insufficient hydro capacity will exist to meet California import expectations.

33 For the Bay Area, lost output estimates range from $1 billion to $5 billion, also impacting the forecast annual growth rate (4.2%) by roughly 0.15% to greater than 1%.

EXHIBIT 37
UNSERVED DEMAND DURING RECENT ROLLING BLACKOUTS

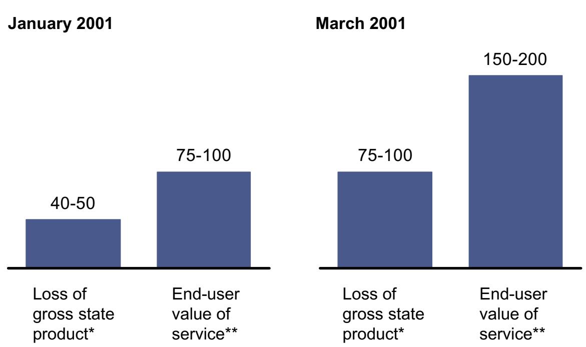
MWh offline



Source: CalSO

EXHIBIT 38
ESTIMATED IMPACT OF ROLLING BLACKOUTS ON STATE ECONOMY

$ Millions



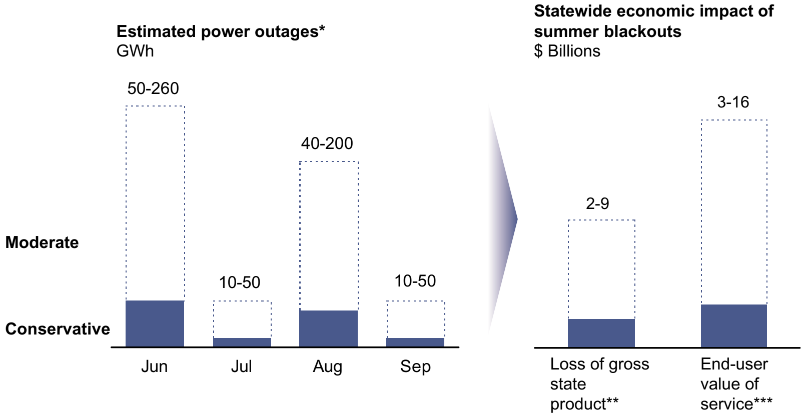
* Based on regression analysis of GSP and commercial and industrial annual energy consumption for 1991-2000, applied to 2001 estimates

** Based on direct cost estimates from PG&E survey using stratified, random sample of 1,200 customer premises

Source: CalSO; PG&E Value of Service studies, February 8, 2000; project team analysis

EXHIBIT 39

POTENTIAL IMPACT OF SUMMER 2001 ENERGY SHORTAGE



* Derived from applying CEC forecasted shortages to historical load curves, with a 10% probability of blackouts when 11% reserve margin is encroached for conservative figures, and a 50% probability for moderate figures

** Based on regression analysis of GSP and commercial and industrial annual energy consumption for 1991-2000, applied to 2001 estimates

*** Direct cost estimates from PG&E survey using stratified, random sample of 1,200 customer premises

Source: CEC; CalSO; PG&E Value of Service Studies, 2/8/00; project team analysis

Each sector of the economy is impacted differently by blackouts. For example, many large, power-intensive industrial businesses have significant self-generation capabilities[34] and may not be as materially affected. However, high tech industries and other Key Industry Groupings in the Bay Area are severely affected when reliable power fails. Only 30% of all respondents indicated that they have backup generation, and only 8% have self-generation capabilities. An overwhelming majority of businesses (71%) indicated that they have no plans for additional or alternative energy resource development in the near future. In short, restoring grid reliability is crucial to most segments.

The most threatened sectors are those that are both rate-sensitive and highly sensitive to blackouts, including Biosciences and Manufacturing (Exhibit 40). In Biosciences, an outage not only poses the threat of spoilage, but can also derail laboratory experiments that are in a critical phase, losing weeks and sometimes months of work. Another form of spoilage, inventory damage, can take place in Manufacturing as well. Composite Structures LLC, an aircraft parts manufacturer, observes that even a brief power failure can ruin $500,000 worth of spoilers and rotor blades. More often, however, manufacturing companies suffer lost productivity because of lost time related to starting up equipment and manufacturing processes after a blackout. Last year, Intel Corp. lost power to its fabrication facility in Arizona due to a grassfire in neighboring New Mexico. Following the 4-hour blackout, it took Intel 28 hours to bring the facility back online, resulting in millions of dollars of lost productivity.

34 There is more than 5,000MW of self-generating capacity in the PG&E system, including more than 1,800 MW in the Bay Area.

EXHIBIT 40

EXPOSURE TO ENERGY CRISIS

Very high
Moderate

Rate sensitivity	Moderate	High
High	• Environmental Technology • Resource Extraction	• Biosciences • Manufacturing - refining/ conversion/processing
Moderate	• Construction, Transportation & Transportation Equipment • Telecommunications • Public Administration	• Banking and Finance • Business Services • Computers and Electronics • Manufacturing - fabrication • Multimedia • Retail Trade • Services • Tourism • Wholesale Trade

Sensitivity to lack of reliable power

Knowledge-based Industry Clusters and Key Employment Sectors crucial to the Bay Area economy can also be dramatically impacted. For example, at companies like Sun Microsystems, Inc., a blackout can cost as much as $1 million per minute.[35] During the January blackouts, Solectron Corp. reportedly idled 2,000 workers, losing millions of dollars in labor and production costs. According to the Silicon Valley Manufacturing Group, an industry association of 190 high tech companies, the January blackouts left 100,000 employees idle, costing tens of millions of dollars.

Lack of confidence in reliable power can lead businesses to consider plans for relocation or to redirect investment outside of the Bay Area. One in five survey respondents indicated that the energy crisis has significantly impacted respondents' consideration of relocation. Three-quarters of the member companies in the Silicon Valley Manufacturing Group consider blackouts a moderate or high risk for 2001, and some companies have drawn up contingency plans for relocation in the event of more frequent rolling blackouts.

Clearly, reliability of power is the critical issue, given its importance to the continued health and growth of the economy. In addition to a potentially staggering loss of economic output, the energy crisis also presents a serious threat to the brand identity of the Bay Area economy. A summer of shortages and rolling blackouts could prompt local businesses to invest elsewhere and discourage new or out-of-state businesses from locating in the Bay Area.

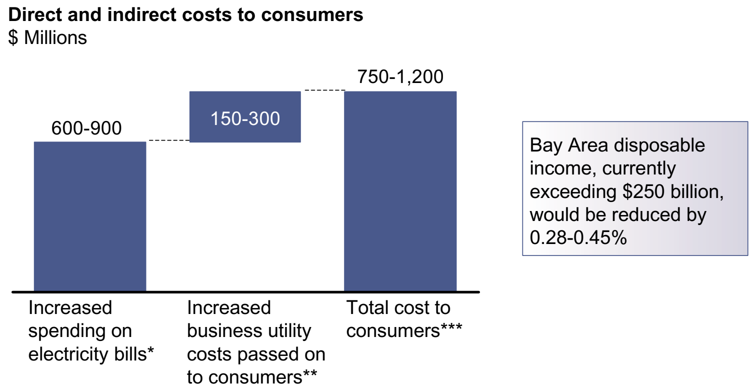
35 Silicon Valley Power, qtd. San Jose Mercury News, December 9, 2000.

RESIDENTIAL IMPACT

Ultimately, residents will bear the cost of the energy crisis through higher utility bills, higher-cost goods and services, higher taxes, and loss of jobs. A 30% increase in residential rates, coupled with a 50% increase in business rates, would ultimately reduce disposable income in the Bay Area by $750 million to $1.2 billion (Exhibit 41); this represents about a third of a percentage point drop. This will negatively impact the future performance of the economy as residents spend less, and local businesses realize lower revenues, which ultimately will manifest as reduced profits and a reduced ability to pay wages and salaries, further slowing overall growth in economic output. Adding to this concern are typical trends in consumer demand where spending is often further curtailed during economic downturns as consumers opt to save rather than spend.

EXHIBIT 41

ESTIMATED IMPACT OF A RESIDENTIAL RATE INCREASE ON BAY AREA CONSUMERS



* Resulting from 30% residential rate increase
** Resulting from 50% non-residential rate increase
*** Assumes spending habits do not change
Source: PG&E; industry interviews; project team analysis

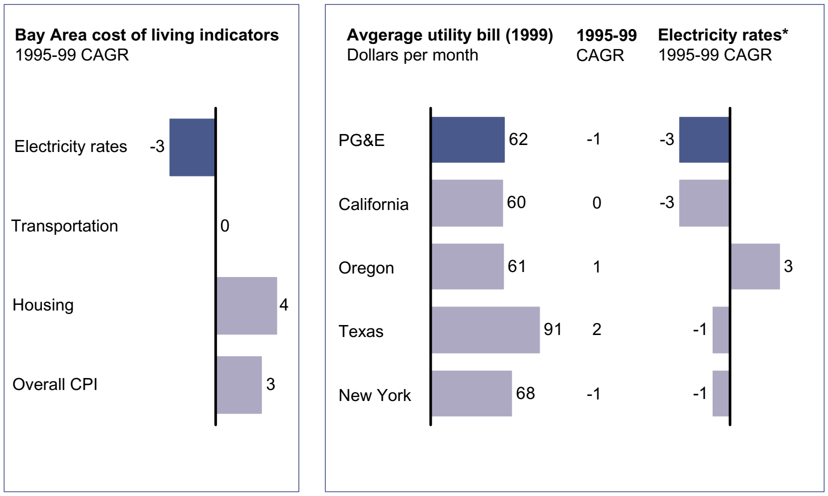
However, three factors suggest that there may be some room for residents to pay higher rates. First, energy costs have not risen at the same rate as a range of other key residential costs. For example, while the cost of housing has increased an average of 4% per year from 1995 to 1999, the cost of electricity actually fell by 3% per year over the same period (Exhibit 42). Additionally, California residents have not experienced the cost increases borne by residents in other major states. California utility bills declined at an average rate of 1% per year from 1995 to 1999, whereas Oregon and Texas experienced average annual increases of 1% and 2%, respectively. Finally, higher rates would stimulate greater conservation. In a survey conducted by Knowledge Networks, only 48% of residents said that they have done everything they can to save electricity, and 25% indicated that there is much more they can do at home to save electricity without much cost or inconvenience.[36] Residential electric load data show that air conditioning alone makes up 41% of residential

36 Results based on a Web-based survey of 452 California residents, conducted February 2-6, 2001.

peak load, or about 14% of total system peak load. Small steps, such as raising the thermostat by a few degrees during peak hours, could substantially reduce strain on the grid. A recent residential poll supports this point, where 69% strongly agreed that they would make a serious effort to use less energy if prices increased.[37] Any adjustment to residential rates should also revise the current structure to increase incentives to conserve.

On top of the economic and financial impact, the perceived inconvenience and impact on the quality of life is potentially more significant. In a residential poll, an overwhelming majority (67%) named the energy crisis and utility insolvency as the most important problems currently facing the state. More importantly, almost as many residents were concerned about supply (76%) as were concerned about cost (78%), suggesting that reliability is a top-of-mind issue for residents, even though only one in three had been directly affected by the blackouts.[38]

EXHIBIT 42
RESIDENTIAL COST COMPARISON



* At the 250 kWh consumption level
Source: Bureau of Labor Statistics; Edison Electric Institutes; project team analysis

SUMMARY

Business leaders join residents in placing the crisis as one of the top threats to the Bay Area, at least as significant as lack of affordable housing, traffic congestion, and poor educational performance (Exhibit 43). Fully 91% of businesses are concerned about the reliability of electric power, and 86% indicated that they are concerned about rising energy costs.

Last year was not a simple one-time spike in demand; in fact, the energy needs of the Bay Area are only going to increase, requiring that infrastructure be constructed to keep pace. Thirty-six percent of businesses said that their energy needs will be higher or much higher over the next three years, and 58% indicated that their energy needs will likely remain

37 Results are based on a telephone survey of 800 California residents, conducted February 13-15, 2001.
38 Results are based on the same telephone survey of 800 California residents, conducted February 13-15, 2001 cited previously. This figure [the percent concerned about reliability of supply] is most likely significantly higher today, given that the survey was conducted in early February, prior to the recent March rolling blackouts. The rolling blackouts in January affected only Northern California, whereas the March blackouts affected both Northern and Southern California.

unchanged. Only 6% expect their energy needs to decrease. Further, the residential population continues to grow in both size and wealth.

Taken together, the crisis presents an enormous threat to the economic welfare of the Bay Area and the State of California as a whole. Rate increases on the order of 25-50% are certain and considerably larger increases are possible. Even so, the potential for summer blackouts remains very real. Fifty-percent business rate hikes alone could reduce Bay Area growth in economic output by more than a half billion dollars, reducing output growth by nearly 0.2%, and resulting in the creation of 15,000 fewer jobs over the next three years. Furthermore, even a modest number of blackouts will impose major costs on the economy, with potential lost Bay Area output from June to September ranging from $1 billion to $5 billion (Exhibit 44), reducing the forecast growth rate by 0.15% to more than 1%. Some projections of the summer power shortfall would generate an economic cost so significant as to push the economy to the verge of recession.

The Bay Area economy remains remarkably robust. The total costs estimated here are significant, but probably manageable. However, every day that the problem goes unaddressed increases the cost of a solution. The need to move quickly and appropriately is clear . . . the lights must be kept on. The Bay Area knowledge economy needs power.

EXHIBIT 43
PERCEPTION OF THREATS TO BAY AREA ECONOMY
Percentage of survey respondents; 100% = 512

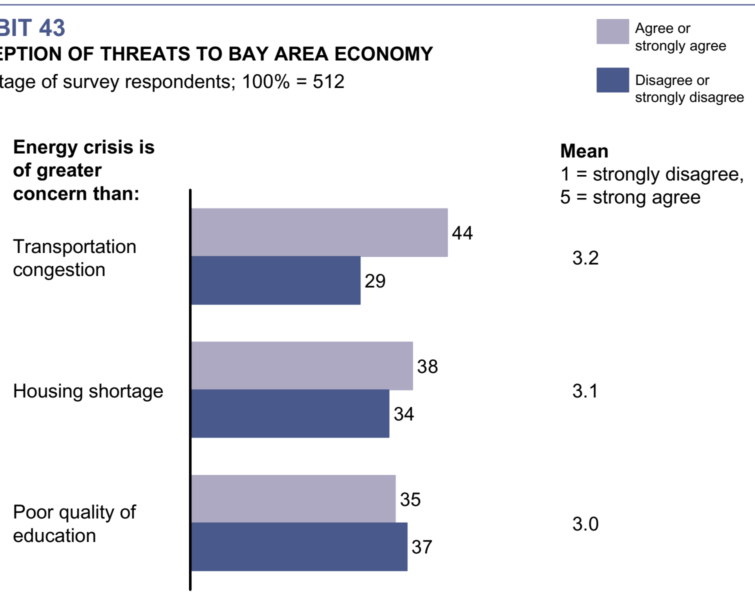
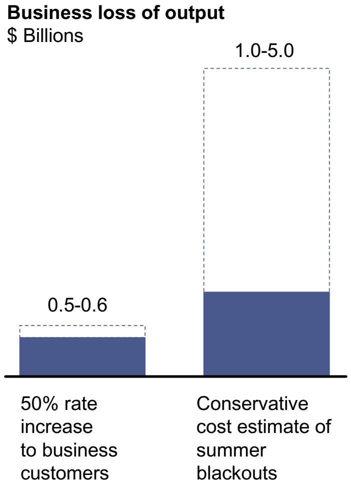


EXHIBIT 44

ESTIMATED IMPACT ON THE BAY AREA ECONOMIC ENGINE



- Despite focus on prices, lack of reliability is the greatest threat to the economy
- $0.8 billion-1.2 billion annual reduction in disposable income
- 15,000 fewer jobs created over the next 3 years due to rate hikes

WHAT MUST BE DONE

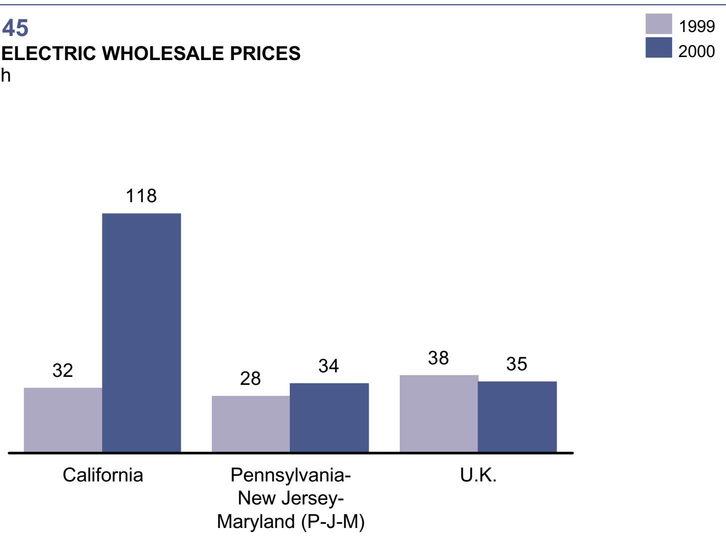
It is important that the state take urgent action to address the current energy problems (Appendix C1). Further, all participants are strongly encouraged to move away from the rhetoric that is polarizing the current debate, and instead focus on the underlying microeconomics, and interrelated policy decisions regarding a host of critical issues, such as fuel mix, permitting and land use, pricing (including wholesale price caps), regional resource sharing, procurement roles and constraints, regulatory jurisdiction and uncertainty, etc.

The direct result of the energy crisis is an enormous financial burden this year – probably on the order of $10-15 billion due to higher wholesale power prices – of which at least 30% flows from the Bay Area. With business leaders joining residents in placing the crisis as one of the top threats to the area, the mandate to act is clear, and the scope for creative solutions is broad. It is critical that policymakers act with a long-term perspective. A well-functioning, competitive wholesale and retail power market will bring valuable benefits to the state's citizens and businesses. The state needs to correct the flaws in its regulatory structure. Since the state’s electric markets were not properly or fully deregulated, competitive electric markets have not been given the chance to succeed; California should remove impediments to competitive markets, not abandon competition. A brief review of the history of deregulation in California and elsewhere reinforces these points.

Deregulation was initially undertaken in California because power consumers were saddled with high costs from a number of poor investment decisions – including nuclear power and a number of renewable energy powered generators – made by the utilities and regulators in the 1970s and 1980s. High energy costs relative to other states were hurting the state's economic competitiveness, driving out businesses, and prolonging the recession of the early- and mid-1990s. Indeed, California's initial experience with a deregulated market was very positive – prices fell by as much as 50% because the state had adequate reserves of available supply. This was good for business and contributed to the spectacular growth experienced in the Bay Area and throughout the state in the latter half of the 1990s.

Wholesale rates in other deregulated markets, including the Pennsylvania-New Jersey-Maryland market in the Eastern U.S. and the long-deregulated United Kingdom market, remained much lower than in California (Exhibit 45). Thus, the problem is not deregulation per se, as a number of deregulated markets have been successful; rather it is the poor design of deregulation in California. In a truly deregulated environment, competition promotes innovation and efficiency, particularly with respect to decisions on capital investment. It would also level the playing field across the West in terms of energy costs.

EXHIBIT 45
AVERAGE ELECTRIC WHOLESALE PRICES
Dollars/MWh



Source: RDI PowerDat; FERC; PJM Interconnect; ESIS

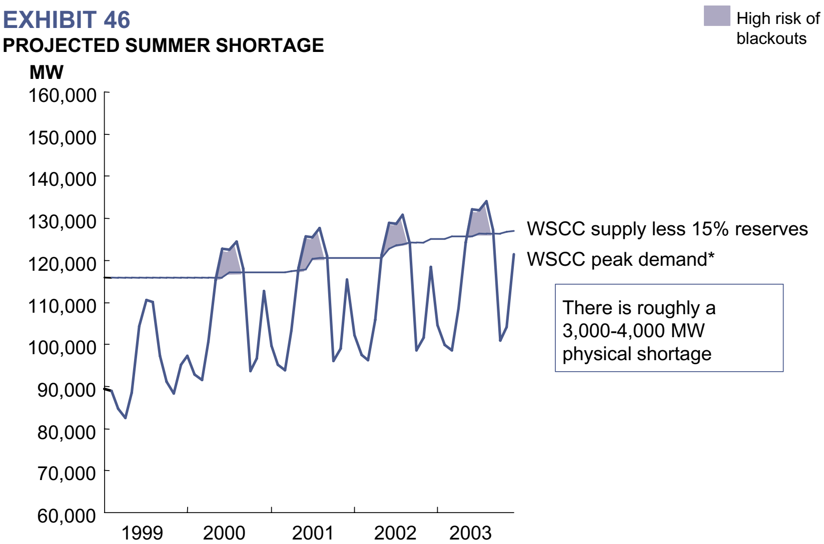
The challenge today is to reform the system in ways that will ensure California experiences the benefits of competition. Reformed market structures should allow both supply and demand to respond rationally to economic conditions; processes and regulations must be streamlined to facilitate rapid construction of new power plants and associated infrastructure such as pipelines and power lines (with attention and respect to long-term environmental concerns), and retail prices must be restructured to stimulate conservation during tight supply situations, thereby forestalling future crises. While these are the goals of reform, the state should address them by dealing with four major issues: (1) the immediate supply-demand imbalance; (2) reform of long-term supply-demand balancing processes, such as permitting and pricing; (3) infrastructure reliability; and (4) long-term public and private sector roles. This section discusses each of these points in turn.

Immediate Supply and Demand Imbalance Relief

California faces a 3,000-4,000 MW electricity deficit next summer (Exhibit 46) and urgent action is required to avert blackouts. Aggressive energy conservation measures should be encouraged, and potentially even mandated. Programs designed to reduce demand are the fastest, most cost-effective, and most environmentally-sensitive means of bringing supply and demand into balance in the immediate future. Reducing demand for electricity will also reduce demand and the premium paid for natural gas in California (as explained in more detail in the first section of this report).

EXHIBIT 46

PROJECTED SUMMER SHORTAGE



* Based on the capacity required to maintain same reserve levels in the WSCC as last year; assumes new generation comes online on standard schedules; does not include accelerated power plant development or end-user demand response forecasts

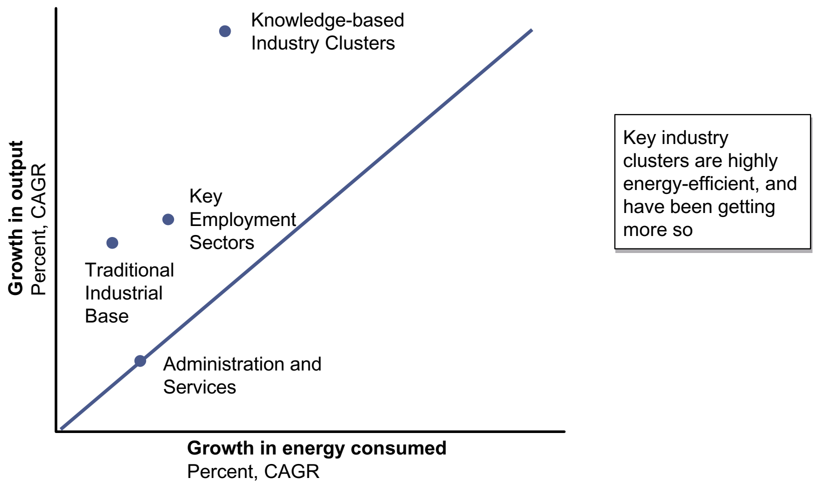
Source: CEC; CalSO; Cal PX; WSCC; EIA; FERC; NERC; project team analysis

Conservation efforts should be targeted at major contributors to peak load. For industrial consumers (26% of peak load) this could mean taking advantage of any remaining opportunities to shift load off-peak. However, given the increased energy efficiency of most industrial and commercial businesses and the 24/7 nature of many industrial processes, these opportunities are likely quite limited (Exhibit 47). Hence, the best near-term alternative is to target end-uses that are more discretionary, including residential and commercial air conditioning and commercial interior lighting, which together comprise 40% of peak load (Exhibit 48; Appendix C2, C3, and C4). Residential consumers should play a major part in the conservation effort, since Bay Area residential consumption has increased considerably on a per capita basis, reflecting a society of increasing wealth that uses a greater number of energy-consuming goods (Exhibit 49). Initial analysis suggests that programs targeting air conditioning and commercial lighting[39] throughout California could reduce peak load by 5,000 MW; a coordinated effort throughout the WSCC could potentially double the benefit. Further, there is reasonable business and residential receptivity to temporary statewide mandates, provided they make sense as part of a larger, coherent plan (Exhibit 50).

39 Raising commercial and residential air conditioning settings to 76 °F; and leveraging commercial 1/3 and 2/3 step-down interior lighting capabilities.

EXHIBIT 47

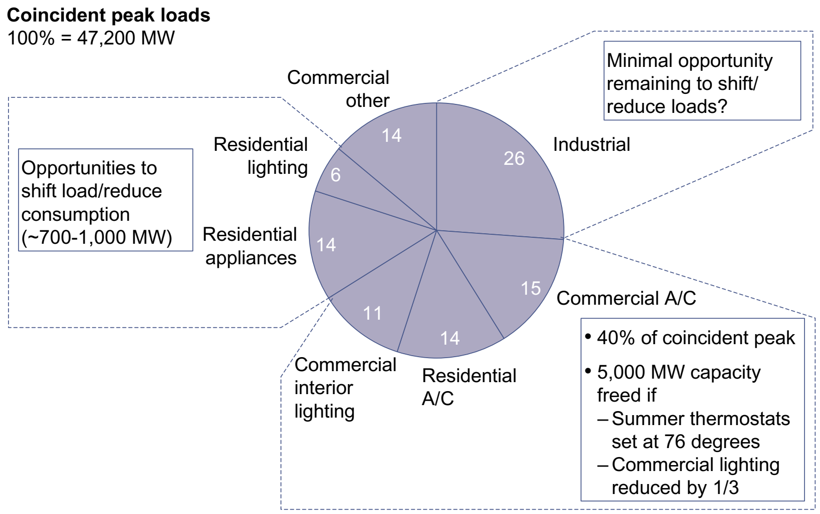
ENERGY EFFICIENCY OF BAY AREA ECONOMIC OUTPUT, 1995-99



Source: Economy.com; PG&E; project team analysis

EXHIBIT 48

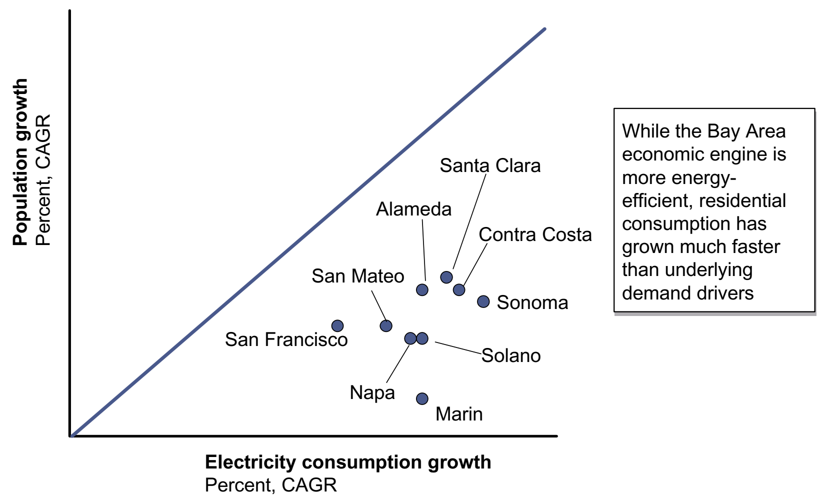
ACTIONS TO ADDRESS DEMAND



Source: CEC; project team analysis

EXHIBIT 49

BAY AREA RESIDENTIAL CONSUMPTION GROWTH, 1995-99



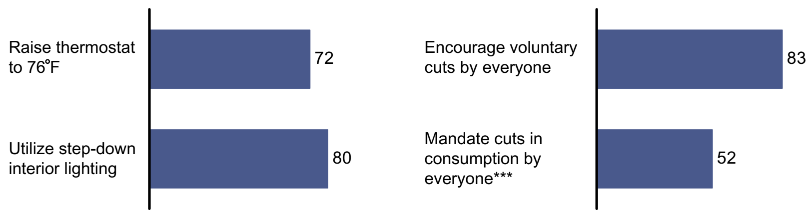
Source: Economy.com; PG&E; project team analysis

EXHIBIT 50

SUPPORT FOR GOVERNMENT-SPONSORED CONSERVATION MEASURES

Bay Area businesses prepared to …
Percentage of survey respondents*
100% = 512

California residents support for measures to …
Percentage of survey respondents**
100% = 800



* Survey conducted March 2001
** Survey conducted February 2001
*** 77% of residents indicated support for measures that would require only businesses to turn down lights and A/C

Source: Evans/McDonough; project team analysis

The role of price in reducing demand should not be overlooked in the list of options available for this summer and beyond. While revising electricity rates is a politically charged issue, it is apparent that significant increases will be necessary to make up for the shortfall of the past year and accurately reflect the higher cost of energy that is likely to persist for at least 2-3 years. Further, it is clear from the previous section of this report that the Bay Area economy, and the state, can absorb significant rate increases if allocated equitably. It is encouraging that the CPUC and the Governor have finally acknowledged this with their respective rate increase proposals and plans.

Ultimately, price is the most effective means of reducing demand. Fully 89% of residents surveyed would make a serious effort to use less energy if prices increased; and 54% of businesses surveyed indicate that price is the most effective mechanism to stimulate conservation (Appendix C5). San Diego's experience last summer demonstrated that residents and businesses conserve when prices rise; and in a parallel Bay Area example, PG&E estimates that gas consumption is down by as much as 5-6% due to similarly elevated prices.[40] Further, Daniel Yergin, a respected economist and chairman of the Cambridge Energy Research Association, commented publicly in early March that a 20% rate hike could eliminate one-third of the supply shortage this summer.[41]

Under appreciated is the importance of rate structure, not just price level, and its effect on consumer behavior. For example, progressive residential rates strongly encourage conservation since the marginal rate of power is much higher than the average rate paid. In addition, for larger commercial and industrial users who already have time-of-use meters in place, the rate hike should be structured not only to encourage conservation, but also to shift loads away from peak hours. For example, a hypothetical 20% average industrial rate hike could be structured so that off-peak rates rise only slightly (0-10%), while peak rates increase considerably more (30-50%).

The current PG&E residential rate structure, in use throughout the Bay Area, involves just two fixed-rate tiers. Up to a predetermined quantity of power (baseline), residents pay about 11.6¢/kWh; whereas above baseline, residents pay about 13.3¢/kWh.[42] To encourage greater conservation, a rate structure could be much more progressive. For example, under one of many possible three-tiered rate structures, average bills could remain unchanged for most consumers (55%), while charging very high rates to those who consume energy well above baseline level (Exhibit 51).[43] This would encourage conservation from the 45% of consumers who use the most energy as their bills would rise significantly (Exhibit 52).

40 Winter 2000-01 as compared to winter 1999-00.

41 Given peak summer electricity shortage estimates of 3,000-4,000 MW, this represents 1,000-1,300 MW of reduced demand.

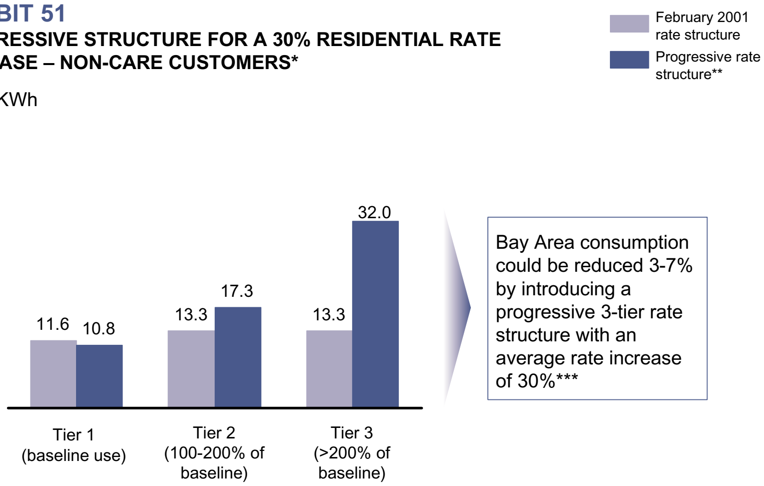
42 CARE, or low-income, customers have a separate rate structure; CARE is available to those households earning less than 200% of the federal poverty level – seniors are eligible if at or below 150% of the federal poverty level.

43 Progressive rate structure used here is based on a rate of 8.7¢/kWh for the first tier, up to 100% of baseline; 12.0¢/kWh for the second tier, from 100 to 200% of baseline; and 25.3¢/kWh for the third tier, above 200% of baseline.

EXHIBIT 51

PROGRESSIVE STRUCTURE FOR A 30% RESIDENTIAL RATE INCREASE – NON-CARE CUSTOMERS*

Cents/KWh



* Customers under (over) 65 years-old earning less than 200% (150%) of the federal poverty level
** Derived from PG&E statistics under assumption that total revenues would increase 30% given identical consumption
*** Assumes a residential elasticity of -0.23 to -0.10 and conservation only from customers who see increases in their bills (Appendix B5); low-income (CARE) rates are assumed to remain unchanged
Source: PG&E; project team analysis

EXHIBIT 52

IMPACT OF A 30% RESIDENTIAL RATE INCREASE – NON-CARE CUSTOMERS

Customer usage percentile	**Estimated electricity bill under February 2001 structure** $/Month	**Estimated electricity bill under progressive structure*** $/Month	**Estimated change in bill** Percent	**Estimated conservation**** Percent
0-18	24	23	-7	0
19-54	53	53	No change	0
55-88	101	121-126	+20-25	3-7%
89-100	180	260-291	+44-61%	7-17%

- Revenue collection increases 20-25%
- Residential consumption drops 3-7%
- Only the 45% of customers who consume the most energy have higher bills

* Derived from PG&E statistics under assumption that total revenues would increase 30%, given identical consumption
** Assumes that customers with increased bills conserve with a -0.23 to -0.10 elasticity of demand (Appendix B5)
Source: PG&E; project team analysis

In addition, if some portion of residential rates were linked to actual energy costs, and floated based on input prices, residents would tend to conserve most when prices were highest (in other words, demand would respond to tight supply conditions). To make this truly effective, residents would need better information about their collective consumption and current pricing, so that the impact on each resident's next utility bill could be clearly understood. Better information through broad awareness campaigns, perhaps using the Internet, is one means of helping residents to recognize the importance of energy conservation, especially during peak hours.

Any immediate or long-term reforms should promote long-term competitiveness, and be distributed equitably across ratepayer classes. Specifically, neither business nor residential consumers should bear a disproportionate share of the total burden; nor should any particular segment receive undue subsidies or penalties. However, accommodation of low-income individuals is essential, and this small segment of residential consumers should continue to be protected. Some specific pricing alternatives that should be considered now, and in the future, include:

- Structuring residential rates more progressively, as discussed above.[44] Low-income residents could be protected by exempting CARE customers from the rate increases and through targeted subsidies.
- Making greater use of time-of-use rate designs[45] where prices change depending on what time of day the power is used. This would strengthen incentives to shift loads away from peak hours but requires sophisticated meters measuring not only how much power is used but when. Many businesses have these, though very few residences do.
- Encouraging adoption of real-time pricing, particularly for large industrial users, to facilitate rapid demand response to tight supply conditions and elevated wholesale prices.[46] This requires even more sophisticated meters that communicate in real time with power suppliers.
- Basing some portion of residential and commercial rates on market prices. In other words, above a certain baseline for instance, prices charged would reflect the average wholesale price of power that the utility or buying authority actually paid over the past month. This would allow demand to respond to tight supply conditions, even before extensive time-of-use or real-time metering capability is available.

Shifting the discussion away from rates only and onto the broader subject of rate structure would reduce the inflammatory nature of this issue and reinforce the important link between prices and demand that has been largely lost in the current debate. Furthermore, residential utility bills in California are quite average for the U.S., despite high rates, due to low usage levels. The increased wealth of many residents over the past 3-5 years suggests an ability to absorb increases (Exhibit 42).

44 Tier 1 rates would apply up to 100% of baseline, Tier 2 up to 200%, and Tier 3 above 200%. Baseline is defined for each region as the minimum load required to operate a household, and is adjusted to reflect seasonal variance. Rate structures with more tiers or different break points are possible, but it is important that they not be so complicated as to confuse residents.

45 Time-of-use structures have fixed rates for a given time of day (typically peak hour rates in the mid-afternoon are higher than off-peak rates in the middle of the night).

46 Real time pricing means that a user pays the spot rate for power consumed in a particular hour; for example, noon to 1pm could be different one day to the next.

In addition, more aggressive interruptible power programs, which pay businesses (or give them discounts) for allowing some portion of their service to be shut off on short notice at critical times, should also be considered.[47] Current programs are small and have already been nearly exhausted. For example, PG&E's 2001 interruptible program addressed only 400 MW of load that could be interrupted for a total of up to 100 hours; today, less then 60 MW of total load can still be shed, and for only a small amount of time. The existing program pays out only a trivial amount to a customer to shed load. Given the very high cost of a blackout to the economy, much higher rates are easily justified and will encourage more businesses to participate. Survey results indicate that 18% of businesses would enroll if paid $250/MWh of load interrupted; this figure rises to 38% of businesses when the rebate is increased to $1000/MWh. Offering a more robust program would more economically distribute available power at times when supply cannot meet demand.

While reducing demand is the quickest route to avoiding blackouts this summer, increasing supply through short-term, temporary means should also be emphasized. Immediate supply relief options include:

- Embarking on an aggressive generation construction program to include both temporary and permanent generators. Options include: accelerating construction of a permanent facility just outside of the state (to avoid aggravating the natural gas supply situation in California),[48] bringing in barge or land-mounted mobile generation, and temporary installation of gas turbines currently destined for installation in facilities under construction[49] in other locations in the U.S. (particularly the Northeast). Initial reviews suggest there may be as much as 500-1,000 MW of mobile generation available, and up to 4,000 MW of capacity that could be available on a temporary or even permanent basis (Exhibit 53). Every day of delay reduces the total amount of new capacity that can be brought on-line in time for this summer.
- Leveraging existing backup generation capacity. Industry estimates suggest there is as much as 400 MW of installed backup capacity in the Bay Area. Unfortunately, most of this capacity cannot be operated in parallel with the system grid. Nonetheless, there may be a limited opportunity to improve notification procedures and permit advance warm-up so that business interruptions are minimized at affected facilities. In any case, it will become necessary to adjust the 200-hour per year operating limits imposed on diesel generators (the vast majority of back-up generation). While the environmental ramifications of extended diesel operation are unattractive, it is probably worth the trade-off on an emergency basis until system reliability is restored.
- Encouraging some gas-fired plants to temporarily switch to liquid fuels. This would reduce demand for natural gas and help drive down gas and electric prices, but would also require that some air quality restrictions be lifted temporarily, and the rehabilitation of some long out-of-service equipment.

47 Customers could be paid a retainer to participate in the program, then, when required, they would be directed to curtail a prescribed amount of load and paid a fee per MWh saved, which could be quite large. The current PG&E program pays only $84/MW-yr (a tiny amount); amounts as high as $500/MWh are justifiable.

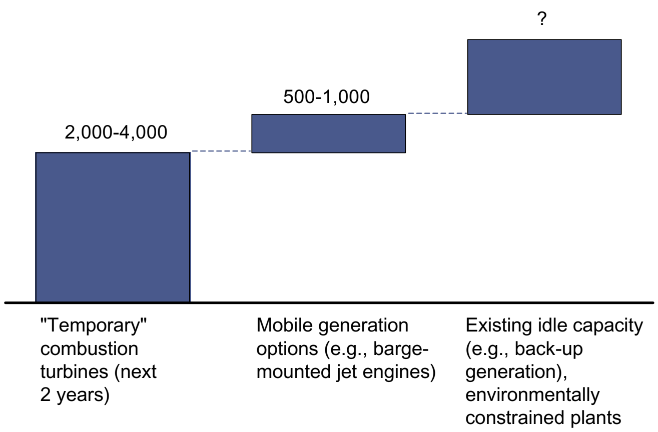
48 Up to 4,000 MW of electric transmission capacity is available to bring additional power into California from Arizona.

49 Turbines are the single most significant item in a new power generation facility. They require very long lead times; there are only a handful currently in the construction "pipeline" that could be sent to California on short notice. Since most of these are already destined for designated facilities, it may be necessary to lease them on a temporary basis until permanent assets are acquired.

EXHIBIT 53

POSSIBLE IMMEDIATE INCREMENTAL SUPPLY OPTIONS

MW



Source: Project team analysis

- Examining and addressing gas and electric infrastructure bottlenecks, especially gas bottlenecks into and within the state,[50] and electric transmission bottlenecks within the state on Paths 15 and 26.
- Re-evaluating water flow restrictions affecting hydro-generation.

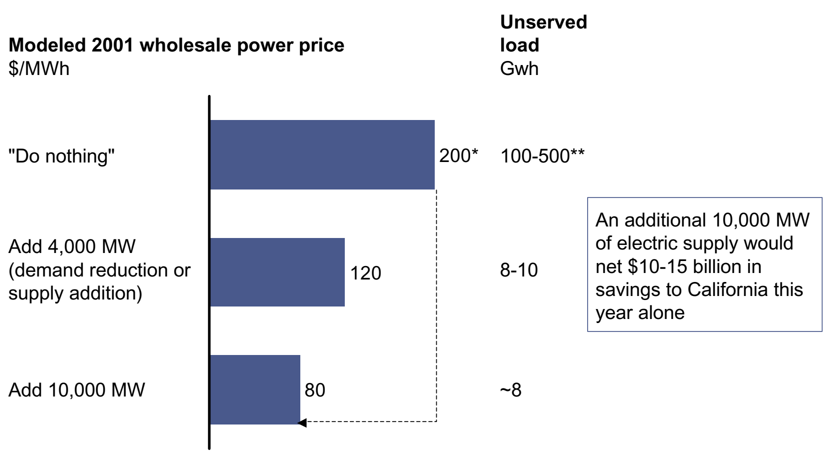
The importance of these efforts to the economy is apparent. A fifty-percent business rate hike alone could reduce Bay Area growth in economic output by more than a half billion dollars, yet even a modest number of blackouts could drive Bay Area output down by $1 billion to $5 billion (Exhibit 44). Hence, bringing supply and demand into balance rationally (i.e., without blackouts) must be the top priority.

50 The capacity to bring gas into the state must be increased if economic growth is to continue and air quality is to be maintained. This can only be achieved by building a new pipeline, or finding some means of safely increasing capacity on existing pipelines.

Modeling electricity prices is very problematic and complex as there are many interdependent variables and there is a great deal of uncertainty about future events such as the weather or the behavior of market participants. Nonetheless, a reasonably sophisticated pricing model suggests that absent aggressive actions on the part of the state, not only will there be frequent blackouts, but the average wholesale electricity spot price in California could be as high as $200/MWh in 2001, as compared to $118/MWh in 2000 and $32/MWh in 1999. Adding capacity, or reducing demand, to make up for the 3,000-4,000 MW shortfall would avoid most blackouts, and reduce expected average wholesale price to about $120/MWh (about the same as last year). If a total of 10,000 MW of new capacity or demand reduction can be found, prices could drop to about $80/MWh, saving the state about $10 billion-15 billion in direct energy costs[51] as compared to doing nothing (Exhibit 54). The potential costs are so high that there is a fair amount of economic flexibility in what we could pay now to improve the situation and still be better off financially in the end.

EXHIBIT 54

ESTIMATED IMPACT OF INCREASED SUPPLY ON WHOLESALE COSTS



* Average year-to-date wholesale electricity prices for on-peak spot market purchases are $289 per MWh at the California-Oregon border, $222 per MWh for Four Corners, and $258 per MWh for North Path 15

** Under less optimistic yet realistic assumptions, the impact of capacity shortages could be 2-4 times greater assumptions, the impact of capacity shortages could 2-4 times greater

Source: CalSO; project team analysis

51 This does not include the indirect cost to the economy as some of the higher energy costs are passed on to consumers, or as companies move out of state in search of lower cost, more reliable energy. In aggregate, these indirect costs are likely many times larger than the direct cost figure.

Reform of Long-term Supply-Demand Balancing Processes

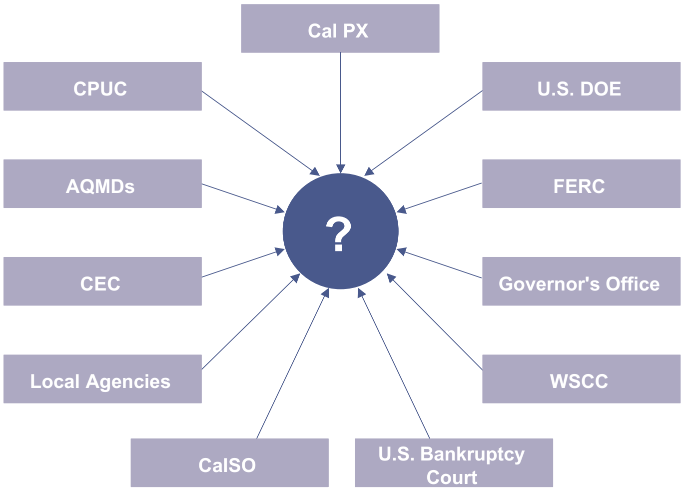
California has an energy infrastructure problem that involves difficult trade-offs and will take years to fully correct. Competing priorities such as air quality, water use and water quality, land use, and fuel diversity, for example, need to be rationalized to allow efficient and timely development of electric generation[52] capacity, as well as electric and gas transmission capacity. In practical terms, this means that permitting processes need to be streamlined as much as possible without compromising competing environmental priorities. Experience in other states suggests that halving the time required is reasonable. Emergency procedures for a 6-month power plant permitting process drafted by the CEC in November 2000, point to the discovery and hearing phases as areas where much time can be saved. For example, in the new process, the discovery phase was shortened from 7 months to 3 months and the hearing phase from 3 months to less than 1 month, still allowing for vital community and third-party input while reducing the time spent on staff assessments and hearings. The state needs to continue to explore ways in which these time savings can be incorporated into the standard, non-emergency permitting process.

A market for buying energy in the future, a so-called forward market similar to other commodity markets, and longer-term contracting should be encouraged to allow both utilities and other power companies to create balanced supply portfolios containing a mix of long-, medium-, and short-term obligations. A forward market is important for the price signals it sends, as well as providing an opportunity to hedge price or supply risks. The combination of forward positions and long-term contracts can significantly reduce the risk to investors constructing new generating stations. It follows that whatever entity is buying power (previously the utilities but currently the state) must be able to sign some long-term contracts to entice suppliers to build, and hence reduce the risk of shortages and high prices.

The negative role of regulatory uncertainty is also important, as it is a serious disincentive to investment. In California, there are too many regulatory bodies (Exhibit 55) with conflicting/overlapping jurisdiction, and there is a tendency to continually revise the rules. State and local leadership must work together to create a regulatory framework that is stable, predictable, and permits market forces to work. Further, there is a need for government, business, and community leadership to work together to address some of the pervasive attitudes that have created a situation in which project development processes are too time consuming, costly, and uncertain. The popular expressions that sum up these problems are NIMBY (Not In My Back Yard), BANANAs (Build Absolutely Nothing Anywhere Near Anyone), and NOPE (Not On Planet Earth).

52 Impediments that preclude efficient development are common across a range of energy generation alternatives, including large generation facilities (thermal, hydro, or other), renewable sources, co-generation and other forms of distributed or micro generation, and backup generation. All face permitting and other bureaucratic obstacles, as well as a number of economic disincentives to investment, and in some cases, technical obstacles to efficient parallel operations with the system grid.

EXHIBIT 55
CALIFORNIA ENERGY REGULATION



The current climate in the state capital is not helpful. Rhetoric advocating strict price caps and controls, condemning generation assets, threatening to appropriate private resources, litigating for return of "excess" profits, levying "windfall profit" taxes, or forgoing payment of past debts, does not create an atmosphere in which generators are encouraged to invest in California (or even simply to operate existing assets in order to sell power into the California wholesale market). This aspect of the current debate is counterproductive given that any viable long-term solution must involve large amounts of new infrastructure. Leadership is required to focus discussion on the underlying microeconomics issues and required policy decisions, and to create an investment environment that will attract the capital necessary to strengthen California's energy infrastructure.

Demand side management should not be viewed only as a short-term band-aid. Energy conservation measures should be developed that are supported by market mechanisms as opposed to individual goodwill or government mandate, as the effectiveness of these alternative approaches wanes through time.

As discussed earlier, the role of price in managing demand is critical. Much as power generators are best served with a balanced portfolio of long-, medium-, and short-term obligations, so too are consumers. Prices paid by consumers should reflect the fact that they are the collective counter-party to the suppliers; and a mix of fixed prices, to provide predictability, and fluctuating prices, to signal tightening supplies, would be ideal. Some exposure to market "spot prices" permits consumers to take advantage when wholesale spot prices are low and encourages them to modify their behavior (and conserve) when wholesale spot prices are high.[53] The easiest way to achieve this is to encourage retail competition, whereby competing retail energy providers can offer consumers a variety of

53 The CTC can and should be structured in such a way that this important price signal is not simply blocked, as it is today.

rate plans, much in the same way that consumers today can choose from a variety of competing home mortgage plans and providers – some have variable interest, others are fixed for 30 years, while others are fixed for the short-term and then become variable. Until such time as retail competition becomes prevalent, creative rate structures could be relied upon to provide consumers with prices that reflect a balanced portfolio of obligations.

Reliable Infrastructure

Incentives for investing in and maintaining a reliable transmission[54] and distribution infrastructure cannot be ignored through this process, as reliable power is at least as critical to the California economy as affordable power. Further, well-managed distribution infrastructure will ensure that we have high-quality[55] power, something which is increasingly important to Bay Area high tech businesses and will grow even more so in the future.

Investor-owned utilities and municipal utility districts have traditionally played this role; however, the state government is currently negotiating purchases of the utilities' transmission lines. While this may well be a stop-gap measure, it is important that these networks continue to be designed and operated by professional managers so that the correct economic signals are sent and received, rational investments are made, and political agendas do not hamper efficient operations.

Long-term Public and Private Sector Roles

California's current regulatory system must be streamlined and simplified. The large number of regulatory bodies, and the lack of clear jurisdictional boundaries, has created a system that is cumbersome at all times and especially slow to respond to problems.[56] The lack of a party responsible for ensuring that adequate reserve margins are maintained is evidence that the current structure permits critical issues to simply fall through the cracks. Consolidating all of the state regulatory roles under a single body, with clear and consistent policy direction, energy expertise, and a mandate to effectively coordinate with the entire western region, would simplify problem solving and help preclude crises in the future.

54 Gas pipeline transmission and high voltage electric power transmission.

55 Reliable power simply refers to assurance that there will be few, if any, interruptions. Quality power refers to how closely and consistently the voltage and frequency of the power actually delivered meet intended levels. "Noise" in the signal can be damaging to some equipment.

56 With PG&E filing for Chapter 11 protection, another jurisdictional claimant has been introduced to the process, the U.S. Bankruptcy Court.

As noted, with the current industry regulatory structure, no party is responsible for ensuring that adequate reserve margins are maintained. This is an area in which the state, or a new multi-state sponsored body, could play a role of great value. There is a clear need for a coordinating role in managing existing capacity in the state,[57] and more broadly across the WSCC, particularly with respect to the timing of major maintenance periods.[58] The task of evaluating existing and expected electric supply, relative to expected demand, is critical. Thus, a coordinating body should fund studies and forecasts necessary to make clear the need for new capacity as the economy grows and facilities age, and make this data widely available. These efforts would complement the price signals delivered by well-functioning forward markets. Should investors fail to take action when clear needs have been identified, the state should build awareness and where appropriate, provide suitable incentives to ensure that California, and indeed the entire western third of North America, enjoys a robust, flexible energy generation and distribution system.

Buying power, which is currently carried out by the Department of Water Resources, should be returned to the private sector as soon as possible. A source of concern is that current government plans, while specifying that the primary state procurement role should not last longer than five years, are silent as to how the state is actually going to exit this role. Further, it is inappropriate that all supply[59] and demand be locked-up in long-term fixed-rate contracts for three major reasons. First, it effectively re-regulates the market for the next ten years – a clear step backwards. Secondly, it locks in supplies at prices that are high by historical standards and may be much higher than what becomes available in the future, potentially creating a new category of stranded costs. Third, supply and demand will not respond appropriately to market price signals if these signals are indefinitely blocked.

In summary, the only procurement role the state should consider in the long-run is the limited one of securing a limited number of long-term contracts designed to ensure the development of adequate *new* capacity. These contracts would serve as an incentive, and would help mitigate risk for investors to construct new capacity in California. They should not extend for the entire life of the new asset, and all such state contracts combined should only address a small fraction of total load. The remainder of power procurement (and price-setting) functions are best handled by the private sector, with adequate wholesale and retail competition, freedom to compete on price, and the ability to enter into a balanced portfolio of long-term, medium-term, and spot commitments.

57 In principle, the Governor's recently announced intention to create a State Power Authority might be a step in the correct direction; however, it is crucial that this new authority's role and powers be much more narrowly defined so that we are not creating another large, inefficient state bureaucracy. It is also unfortunate that no effort seems to have been made to reduce jurisdictional overlap and confusion, rather it seems only to be getting worse – the Governor did not announce any intention to abolish or merge any existing bodies with this new organization.

58 Ensure nuclear maintenance and refueling activities are not scheduled simultaneously; monitor scheduled maintenance periods at thermal plants to ensure outages at completing plants are staggered throughout the winter period. Penalties could be levied if a plant is shutdown for an excessive number of days per year, or for failure to comply with shutdown coordinating efforts.

59 While the actual contract details remain unclear, some news reports suggest that as much as 85% of California's base requirements may be covered by long-term contracts.

There may be a case in which select assets, such as transmission lines or hydro-generation facilities, are most appropriately owned by the state. They could be financed with tax-free bonds and have a lower cost of capital. Additionally, bringing northern and southern California networks under single management would help alleviate bottlenecks and distribute resources more equitably. The state has a long record of poor capital investment decisions in the energy business either directly[60] or indirectly,[61] invariably inflating energy costs in the state; further, the state has no demonstrated expertise in daily operation and maintenance. While it may be appropriate and worthwhile for the state to contribute capital (and serve as asset owner),[62] there is no reason to assume that capital decision-making or operating performance is likely to improve; hence, these are roles best left to the private sector.

California must move aggressively to address this crisis, and it must do so in ways that do not transfer the cost of past mistakes to future generations, hindering competitiveness. Given the concentration of "new economy" businesses, which have been hit hard in the current economic slowdown, the imperative for action is greatest in the Bay Area. The Bay Area Economic Forum and its sponsoring partners, the Bay Area Council and the Association of Bay Area Governments, strongly urge the state to take the necessary actions, and further encourages government, business, and community leaders to work together to find creative solutions to this crisis.

60 By signing long-term contracts at a time a record high prices, which will lock-in these elevated costs for years; or by paying too much for transmission assets and forcing the California ratepayer to finance this overpayment over the next several years.

61 By encouraging, via the CPUC and other regulatory bodies, fully-regulated utilities to make costly capital investments in the 1970s and 1980s which California ratepayer are still paying for today.

62 There is a strong sentiment brewing about the potential for creation of Municipal Utility Districts, based on the (overly) simple observation of how well positioned the Los Angeles Department of Water and Power (LADWP) seems to be today. While the benefits of funding infrastructure with lower cost muni-finance are clear, the additional complexities surrounding municipalization have not yet been adequately studied. There is some cause for concern in any effort intended to remove responsibility for infrastructure design, operation, and maintenance from the private sector.

Appendix A

APPENDIX A1

EXAMPLES

CONSTANTLY CHANGING RULES AND REVISIONS TO RULES

	Key legislation		Principal issues
AB 1890 1996	• AB 360 • SB 1305 • AB 1775 • CPUC Order 166 • SB 110 • SB 90 • AB 1154		• Refine rules to address issues surfaced during implementation • Coordinate participants and expand procedural detail • Provide transparency and environmental safety
San Diego price run-up 2000	• • •		• • •
2001	• AB 265 • AB 1970 • AB 1156 • SB 1388 • SB 1194 • AB 995 • AB 918 • AB 94	• SB 552 • SB 1771 • AB 2705 • SB 38 • AB 58 • SB 36 • SB 47 • AB 1	• Skyrocketing wholesale prices • Capacity shortages • Transmission constraints • Inadequate pricing regulations • Permitting/environmental impediments

Plus over 35 additional legislative amendments

Deregulation was a "moving target" as market rules were frequently changed

Source: California State Assembly Web site

APPENDIX A2

KEY FEATURES OF AB 1890 (PASSED AUGUST 1996)

Intention	Major provision
Provide an efficient market-based wholesale price-setting mechanism and ensure grid reliability	• Created non-profit ISO and PX entities to enable orderly wholesale market and dispatching operations
Prescribe quick transition to customer choice	• Directed the CPUC to establish customer-direct access schedule to reach 100% access by 1/1/02
Accelerate recovery of stranded costs and speed market to full competition	• Stranded investment recovery – To be completed prior to 12/31/01 – Beyond 2001, IOUs at risk for recovery of any remaining stranded costs – Competitive transition charge (CTC) calculated as the difference between frozen retail rates and cost to supply electricity*
Ensure consumers would realize rate reductions immediately	• Retail prices – Frozen for large C&I and industrial customers – 10% automatic rate reduction for small commercial and residential customers

Risks inherent in AB 1890 were never understood

* Wholesale commodity price as determined by PX plus transmission and distribution charges

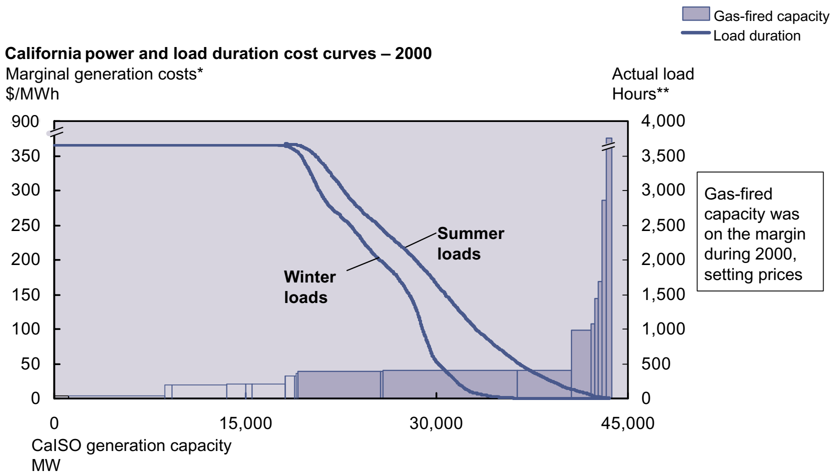
Source: Regulatory Research Associates; project team analysis

APPENDIX A3

NATURAL GAS-FIRED UNITS ARE ON THE MARGIN

ESTIMATE

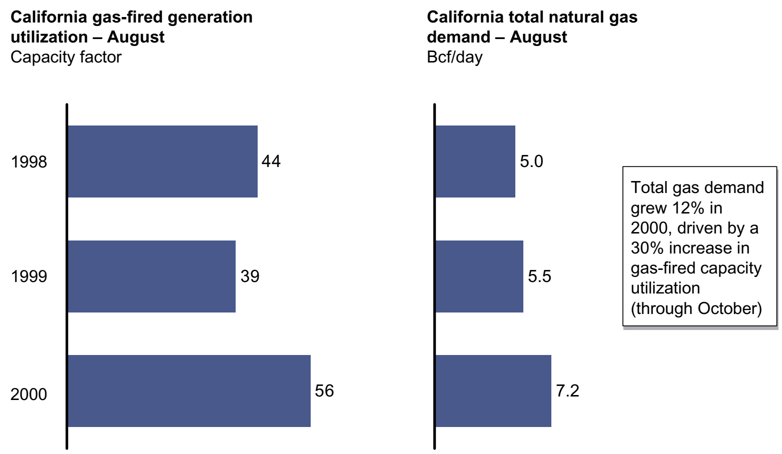
California power and load duration cost curves – 2000



* Based on the capacity-weighted average of generator-reported monthly fuel costs for May-September; does not include NOx credit costs
** Total hours at given level of demand for 10/99-2/00, and 5/00-9/00
Source: RDI base case; RDI PowerDat; CalSO; project team analysis

APPENDIX A4

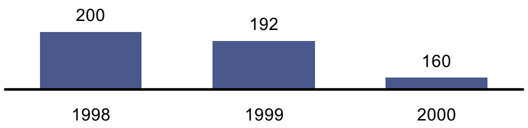
GAS-FIRED GENERATION DROVE GROWTH IN TOTAL GAS DEMAND



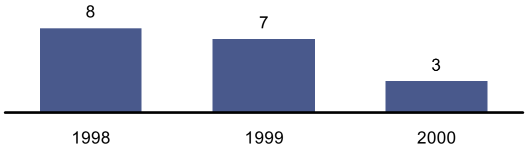
Source: RDI GasDat; EIA Short-Term Energy Outlook

APPENDIX A5
CALLIFORNIA GAS INJECTION

Peak storage volume*
Bcf



Gas injection period
Months



Low storage volume and shorter injection period were driven by high demand from generators

* EIA actual through September 2000; EIA estimated storage levels using historical AGA Western U.S. levels and CA utility press releases

Source: Energy Information Administration; RDI GasDat; project team analysis

Appendix B

APPENDIX B1
KNOWLEDGE-BASED INDUSTRY CLUSTERS

	Output 1999 $ Billions	CAGR 1995-99 Percent	Employment 1999 Thousands	Electric consumption GWh	CAGR 1995-99 Percent
Banking and Finance	22	15	120	470	2
Biosciences	5	4	40	600	14
Computers and Electronics	28	22	130	1,460	6
Environmental Technology	2	6	20	270	-1
Multimedia	15	19	90	690	7
Telecommunications	22	19	110	830	5
Tourism	5	5	100	1,120	3
Total	100	17	610	5,440	6

Source: Economy.com; PG&E; project team analysis

APPENDIX B2
KEY EMPLOYMENT SECTORS

	Output 1999 $ Billions	CAGR 1995-99 Percent	Employment 1999 Thousands	Electric consumption GWh	CAGR 1995-99 Percent
Business Services	11	5	210	220	8
Retail Trade	29	10	510	4,560	3
Wholesale Trade	21	11	150	490	4
Total	61	9	880	5,270	3

Source: Economy.com; PG&E; project team analysis

APPENDIX B3
TRADITIONAL INDUSTRIAL BASE

	Output 1999 $ Billions	CAGR 1995-99 Percent	Employment 1999 Thousands	Electric consumption GWh	CAGR 1995-99 Percent
Construction, Transportation & Transportation Equipment	24	8	310	1,090	-2
Manufacturing - fabrication	16	13	130	1,090	6
Manufacturing - refining/conversion/ processing	18	4	140	4,520	-4
Resource Extraction	3	9	20	350	6
Total	61	8	600	7,050	-2

Source: Economy.com; PG&E; project team analysis

APPENDIX B4
ADMINISTRATION AND SERVICES

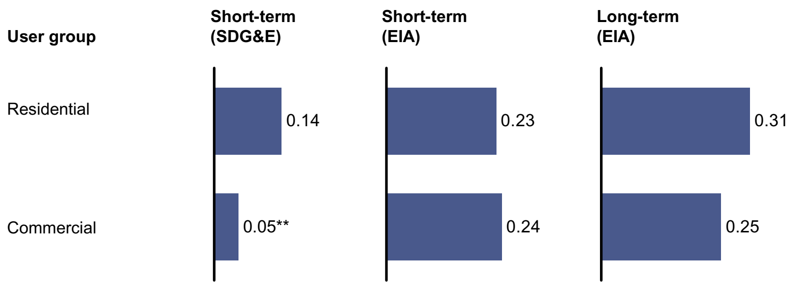
	Output 1999 $ Billions	CAGR 1995-99 Percent	Employment 1999 Thousands	Electric consumption GWh	CAGR 1995-99 Percent
Public Administration	26	0	480	700	-1
Services*	57	5	720	5,780	3
Miscellaneous/Other	6	7	80	230	0
Total	89	3	1,290	6,710	2

* Includes legal services, health services, insurance, real estate, and education services

Source: Economy.com; PG&E; project team analysis

APPENDIX B5

PRICE ELASTICITY OF DEMAND FOR ELECTRICITY*



For each 1% increase in price, short-term demand can be expected to decrease by 0.05-0.25%

* $E = \frac{\Delta Q/Q}{\Delta P/P}$, where P = price and Q = quantity; figures are stated in absolute value terms but reflect negative elasticities

** Includes industrial consumers

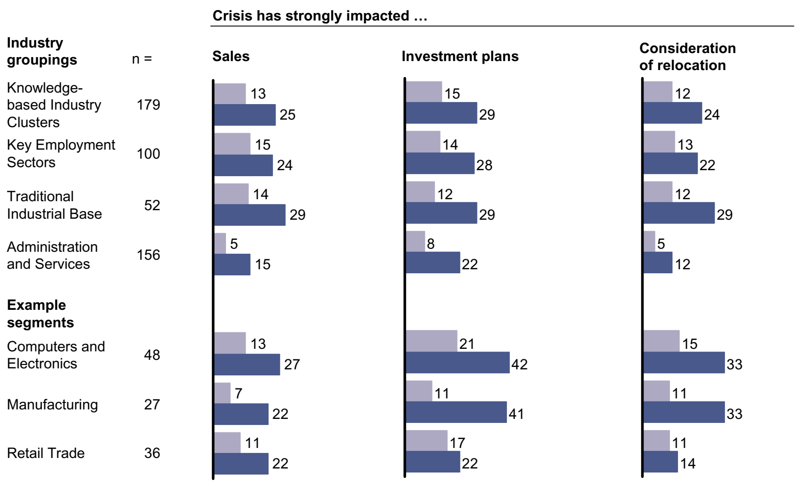
Source: Energy Information Administration, "Issues in Midterm Analysis and Forecasting," 1999; Energy Journal; SDG&E

APPENDIX B6A

IMPACT OF ENERGY CRISIS BY SECTOR

Percentage of survey respondents; 100% = 512

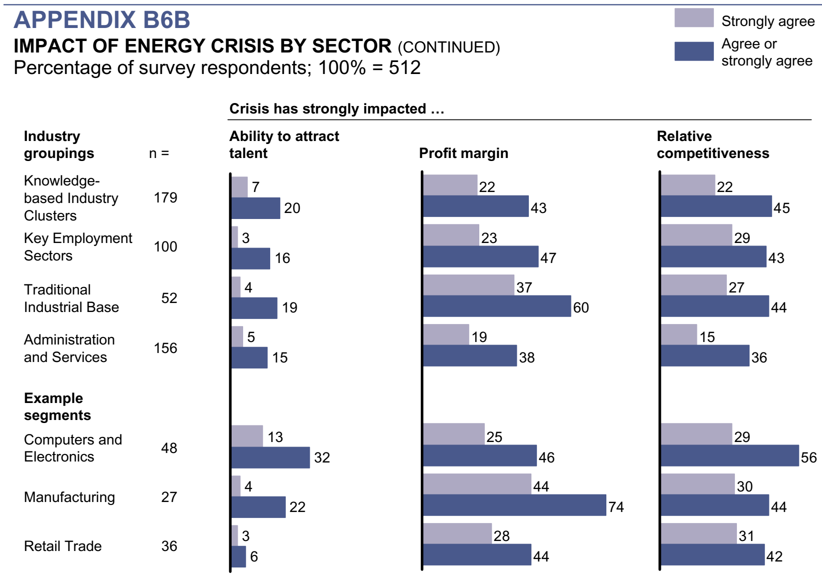
Strongly agree
Agree or strongly agree



APPENDIX B6B

IMPACT OF ENERGY CRISIS BY SECTOR (CONTINUED)

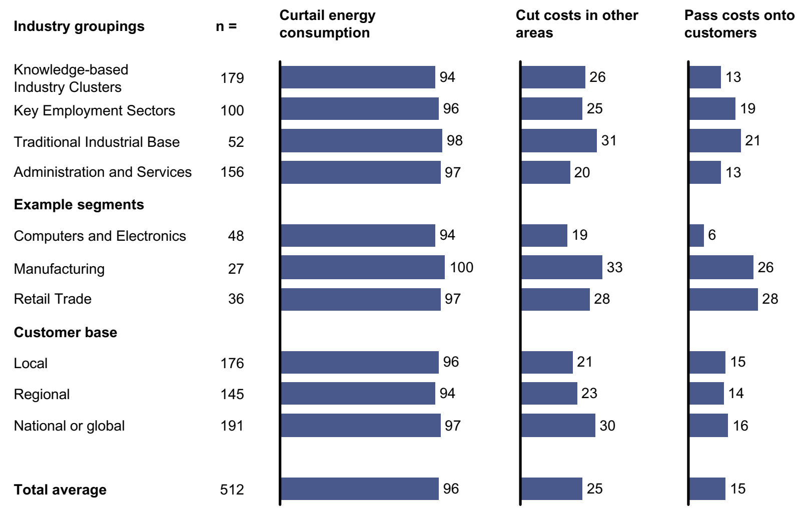
Percentage of survey respondents; 100% = 512



APPENDIX B7A

ACTIONS TAKEN IN RESPONSE TO HIGHER ENERGY COSTS

Percentage of survey respondents; 100% = 512



APPENDIX B7B

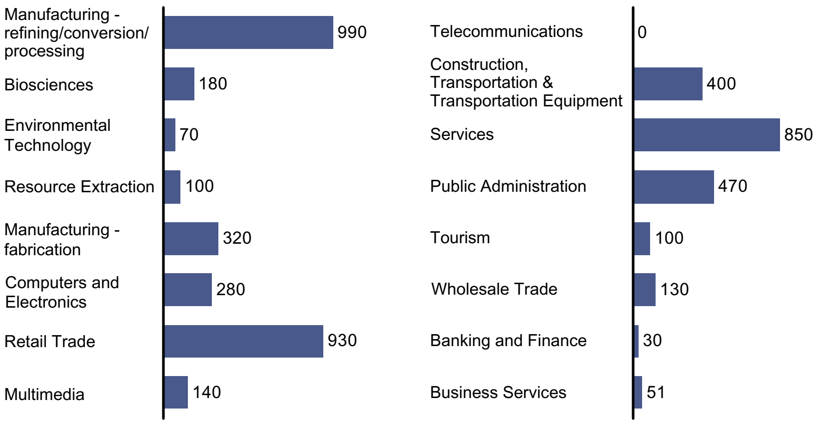
ACTIONS TAKEN IN RESPONSE TO HIGHER ENERGY COSTS (CONTINUED)

Percentage of survey respondents; 100% = 512

Industry groupings	n =	Curtail operations	Reduce staff	Other	None
Knowledge-based Industry Clusters	179	11	5	7	5
Key Employment Sectors	100	13	7	8	1
Traditional Industrial Base	52	12	2	6	2
Administration and Services	156	14	2	8	3
Example segments					
Computers and Electronics	48	8	2	10	6
Manufacturing	27	22	0	7	0
Retail Trade	36	8	6	11	0
Customer base					
Local	176	11	2	6	2
Regional	145	12	3	8	5
National or global	191	12	5	7	2
Total average	512	12	4	7	3

APPENDIX B8

ESTIMATED BAY AREA JOB LOSS DUE TO A 50% BUSINESS RATE INCREASE



Source: PG&E; industry interviews; project team analysis

APPENDIX B9A

IMPACT OF A 50% BUSINESS RATE INCREASE

	Percentage conserved	Percentage of cost passed on to customer	Estimated decrease in … Annual output $ Millions	Estimated decrease in … Growth Percent
Manufacturing - refining/conversion/processing	5-10	25-35	130	0.72
Biosciences	10-15	0-10	20	0.49
Environmental Technology	10-15	10-15	10	0.40
Resource Extraction	20-30	0-10	10	0.39
Manufacturing - fabrication	5-10	10-15	40	0.24
Computers and Electronics	5-10	0-10	60	0.21
Retail Trade	10-15	60-80	50	0.18
Multimedia	10-15	10-15	20	0.16

Source: PG&E; industry interviews; project team analysis

APPENDIX B9B

IMPACT OF A 50% BUSINESS RATE INCREASE (CONTINUED)

	Percentage conserved	Percentage of cost passed on to customer	Estimated decrease in … Annual output $ Millions	Estimated decrease in … Growth Percent
Telecommunications	10-15	10	30	0.13
Construction, Transportation & Transportation Equipment	5-10	30	30	0.13
Services	10-15	70	70	0.12
Public Administration	5-10	10	30	0.10
Tourism	5-10	90	5	0.09
Wholesale Trade	5-10	10	20	0.08
Banking and Finance	10-15	70	10	0.02
Business Services	10-15	70	5	0.02

Source: PG&E; industry interviews; project team analysis

Appendix C

APPENDIX C1

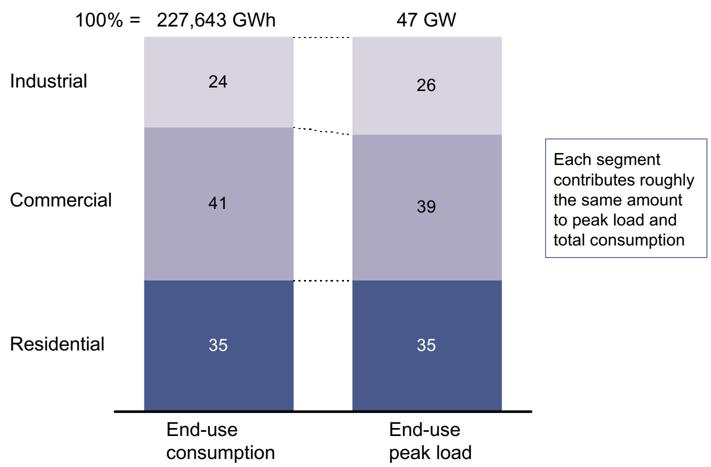
WHAT DO WE DO ABOUT IT?

Timeframe	Issues	Needed outcomes
Immediate **Solvency crisis**	*Creating liquidity* • Utility solvency • Possible delivery curtailments • Federal vs. state jurisdiction • Contract risks/ intergenerational equity	• Credit guarantees • Structured financing mechanism
Next 6-18 months **Supply/demand imbalance**	*Restoring supply/demand balance* • Summer blackout risks • Winter gas curtailments • Excess payments to suppliers	• 10,000 MW demand reduction/new capacity addition • Similar actions on gas deliverability
Long-term **Market reform**	*Reforming power/energy policy* • Capacity addition process • Demand responsiveness • Fuel mix • Market structure/rules • Public vs. private sector roles	• Create a micro-economically sound market with mechanisms to attract timely capacity addition and incentives for demand reduction

APPENDIX C2

END-USE ELECTRIC CONSUMPTION AND PEAK LOAD*

Percent



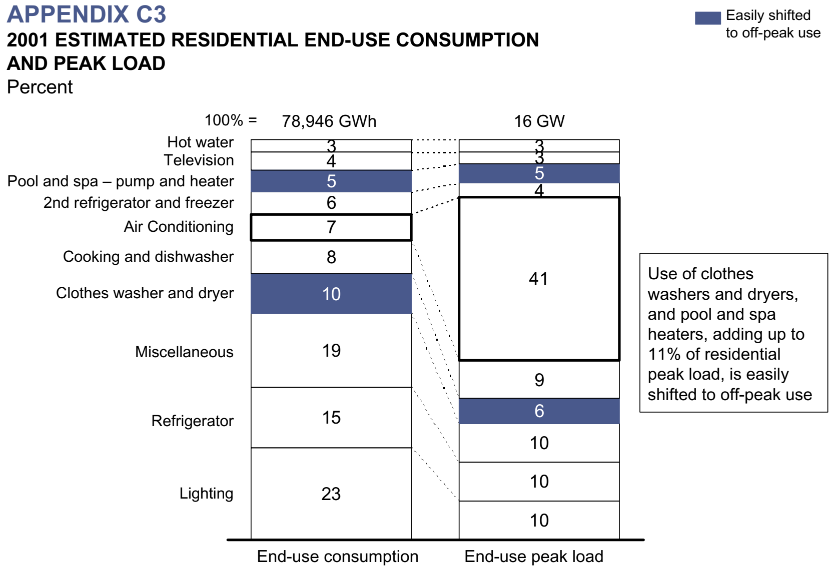
* Agriculture not included in end-use electric consumption or peak load

Source: CEC

APPENDIX C3

2001 ESTIMATED RESIDENTIAL END-USE CONSUMPTION AND PEAK LOAD

Percent

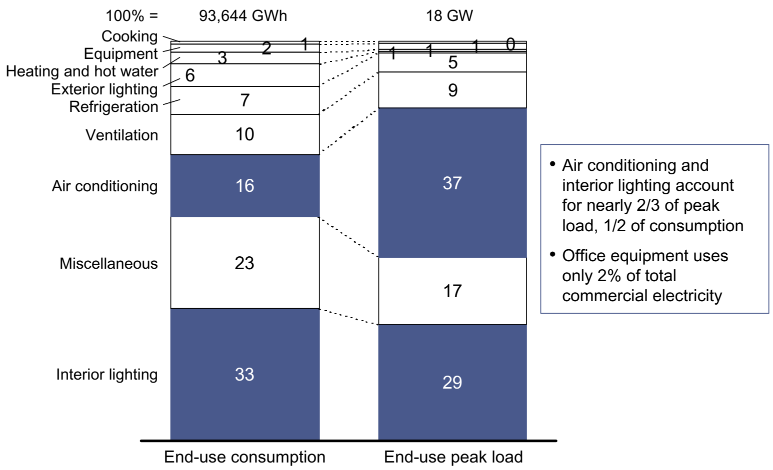


Source: CEC; CALMAC

APPENDIX C4

2001 ESTIMATED COMMERCIAL END-USE CONSUMPTION AND PEAK LOAD

Percent

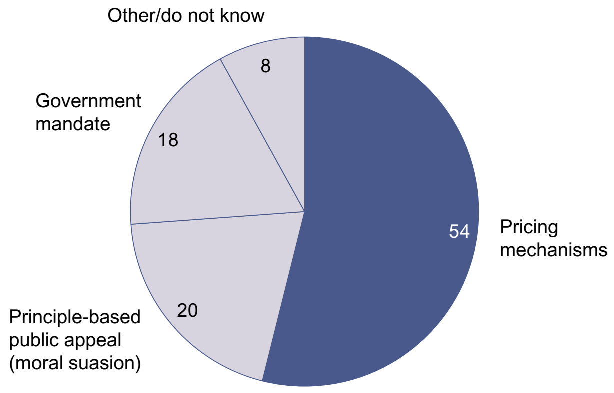


Source: CEC; CALMAC

APPENDIX C5

MOST EFFECTIVE MEANS OF ENSURING ADOPTION OF CONSERVATION MEASURES

Percentage of survey respondents; 100% = 512



Appendix D – Glossary

Air Quality Management Districts (AQMDs) – A local agency charged with controlling air pollution and attaining air quality standards.

British Thermal Unit (Btu) – The standard measure of heat energy. It takes one Btu to raise the temperature of one pound of water by one degree Fahrenheit at sea level. For example, it takes about 2,000 Btus to make a pot of coffee.

CAGR – Compounded Annual Growth Rate, or an effective year over year rate of growth.

California Independent Systems Operator (CaISO) – A neutral operator responsible for maintaining the balance of the electric grid by controlling the dispatch of flexible plants to ensure that loads match resources available to the system.

California Power Exchange (Cal PX) – The California Power Exchange Corporation, a state chartered, non-profit, public benefit corporation charged with providing Day-Ahead and Day-Of markets for energy and ancillary services.

Capacity Factor – The ratio of the electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

Co-generator – A self-generation facility, usually owned by a business with significant industrial steam and / or electric loads. This facility produces steam and electricity to cover all or part of the site requirements. It may be oversized to permit sale of excess electricity to the system grid. Co-generators may also be a qualifying facility (QF).

Congestion – A condition that occurs when insufficient electric transfer capacity is available to simultaneously implement all scheduled loads.

CPUC – California Public Utilities Commission.

Cubic Feet (cf) – A common unit of measurement of natural gas volume. It equals the amount of gas required to fill a volume of one cubic foot under stated conditions of temperature, pressure and water vapor. One cubic foot of natural gas has an energy content of approximately 1,000 Btus.

Decatherm – A unit of heat energy equaling ten therms or 100,000 Btus.

Distribution – The delivery of electricity to the retail customer's home or business through low voltage distribution lines.

Day-Ahead Market – The forward and pre-scheduled market for energy and ancillary services to be supplied during the settlement period of a particular trading day. It is administered by the ISO based on schedules submitted by CalPX and other scheduling coordinators.

FERC – Federal Energy Regulatory Commission, an independent regulatory agency within the Department of Energy that regulates the transmission, sale, and other key issues in interstate commercial energy markets.

Gigawatt (GW) – One thousand megawatts, or one million kilowatts or one billion watts of electricity. One gigawatt is roughly the amount needed to supply electricity to about one million homes.

Gigawatt Hour (GWh) – One million kilowatt hours of electric power.

Gross Product – See output.

Heat Rate – A measure of efficiency for a fossil fuel power plant. The heat rate equals the number of Btus required to produce a kWh of electricity.

Henry Hub – Henry Hub is the recognized benchmark price for natural gas trading in the U.S. (located on the U.S. Gulf Coast)

Investor Owned Utility (IOU) – a utility entity whose assets are owned by investors.

Kilowatt (kW) – One thousand watts of electricity. One kilowatt is roughly the amount needed to supply electricity to one home.

Kilowatt Hour (kWh) – A commonly used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour. Typical residential electricity bills will use kilowatt hours as units. A kilowatt hour might cost about 12 cents.

Load – The amount of energy being delivered to any point, or points, in the system at a given time.

Market Based Pricing – System in which retail charges for generation reflect actual average wholesale generating costs incurred by the relevant procurement authority to purchase power for a group of consumers over a given period. In this case, residential rates may go up and down depending on wholesale prices. This is similar to what existed briefly in San Diego last summer.

MBtu – One Thousand British Thermal Units.

Mcf – One Thousand Cubic Feet. A typical residential bill might use Mcfs as the units for gas consumed.

Megawatt (MW) – One thousand kilowatts or one million (1,000,000) watts. One megawatt is roughly the amount needed to supply electricity to one thousand homes.

Megawatt Hour (MWh) – One thousand kilowatt hours of electric power.

MMBtu – One million British Thermal Units.

MMcf – One million cubic feet.

Nameplate Capacity – the maximum electrical generating output (in MW) that a generator can sustain over a specified period of time when not restricted by seasonal or other deratings as measured in accordance with the United States Department of Energy standards.

NOx Credits – Permits issued by the state to allow the release of nitrogen oxides, a chief component of air pollution produced by the burning of fossil fuels.

Output – The value-added of the products and services produced, or the sum of wages and salaries and pre-tax profits accruing to an industry.

Progressive Pricing – A pricing system that encourages conservation by charging higher marginal rates for power than the average rate.

Qualifying Facilities (QFs) – An individual (or corporation) who owns and/or operates a generation facility, but is not primarily engaged in the generation or sale of electric power (usually a cogenerator).

Real-Time Market – The competitive generation market controlled and coordinated by the ISO for arranging real-time power balances.

Real-Time Pricing – The ability to charge different prices for electricity, based on the time the electricity was consumed. With real-time pricing, utilities could charge more for one kilowatt hour in the middle of a summer day, for instance, than for one kilowatt hour consumed in the middle of the night. Furthermore, the price may change from day-to-day as wholesale prices fluctuate. Currently, most residential consumers are not billed at the same rate for each kilowatt hour consumed, regardless of when it was consumed.

Reliability – The ability of the electric system to deliver energy in the amount demanded by the customer.

Stage 1 Power Emergency – When electricity power operating reserves fall below 7%

Stage 2 Power Emergency – When electricity power operating reserves fall below 5%

Stage 3 Power Emergency – When electricity power operating reserves fall below 1.5%

Stranded Costs – Certain capital investments, such as nuclear power plants and power purchase contracts, made by California utilities that are unrecoverable under a deregulated, competitive system.

Terawatt (TW) – One thousand gigawatts, or one million megawatts, or one billion kilowatts or one trillion watts of electricity.

Terawatt Hour (TWh) – One thousand gigawatt hours of electric power.

Therm – A unit of heat energy equaling 100,000 Btus. Therms are often the units used to measure gas consumption on residential bills. A retail therm might cost about $1.25.

Time-of-Use Pricing (T.O.U.) – The ability to charge different prices for electricity, based on the period time in which the electricity was consumed. With T.O.U. pricing, utilities could charge more for one kilowatt hour consumed between 3:00 and 4:00 p.m. on a summer day, for instance, than for one kilowatt hour consumed between 1:00 and 5:00 am. Most industrial users with loads greater than 500 megawatts are required to use T.O.U. meters.

Transmission – Transporting bulk power over long distances at extremely high voltages.

WSCC – Western Systems Coordinating Council, which provides the coordination that is essential in operating and planning a reliable and adequate electric power system for the western part of the continental United States, Canada, and Mexico.

* Sources include glossaries from the CaISO, the CalPX, the DOE, and the CEC.